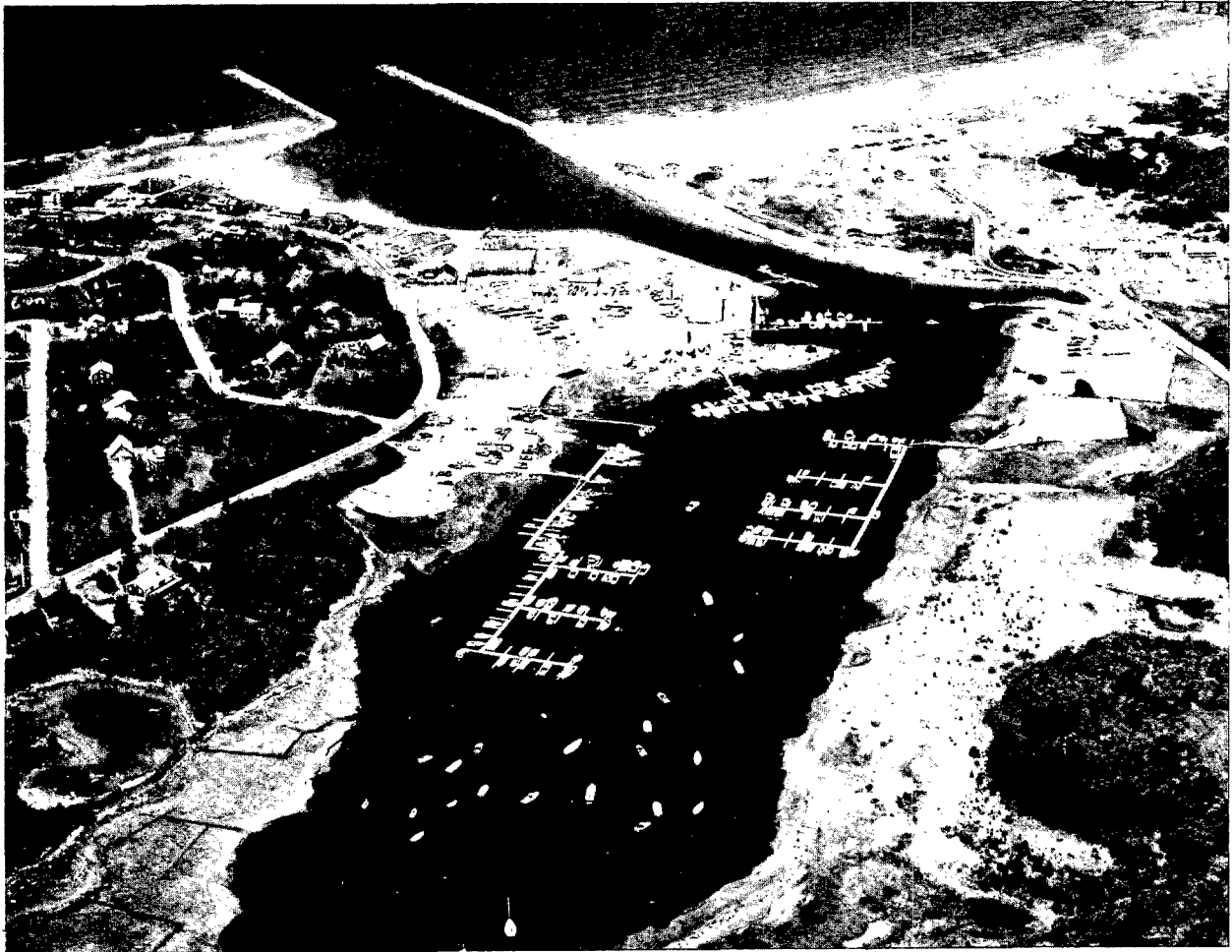


SMALL NAVIGATION PROJECT SESUIT HARBOR DENNIS, MASSACHUSETTS

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DETAILED PROJECT REPORT AND ENVIRONMENTAL ASSESSMENT

DEPARTMENT OF THE ARMY NEW ENGLAND DIVISION CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

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NOVEMBER 1978

REVISED JANUARY 1980

SESUIT HARBOR, DENNIS, MASSACHUSETTS

DETAILED PROJECT REPORT

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SYLLABUS

This study investigated navigation needs in Sesuit Harbor, Dennis, Massachusetts, to determine the advisability of providing navigation improvements for recreational boaters using the harbor.

The most urgently needed improvement is the provision of reliable access through the entrance channel. A safe entrance channel will allow the town of Dennis to develop existing marina facilities to their fullest to help meet the expected continued growth in demand for recreational boating facilities in the Cape Cod area.

Several alternatives were analyzed in an attempt to find the optimal improvement plan to meet the needs of recreational boaters in Sesuit Harbor. The results of this analysis and the demonstrated interest of the town of Dennis indicate that the most feasible plan of improvement at this time consists of a channel, 6 feet deep, varying in width from 100 to 80 feet, from deep water in Cape Cod Bay to a point in the vicinity of the state boat launching ramp, a total distance of 2400 feet.

Local interests will provide for disposal of dredged material consisting primarily of clean sand on the beach west of the harbor entrance. Local interests will further reserve this same disposal area to receive the dredged material from periodic maintenance of the navigation channel.

Based on present and prospective waterway use, the selected plan is economically justified. Total cost would be \$228,000 to be shared equally by the town of Dennis and the federal government. Annual charges of \$45,100 when compared to annual project benefits of \$198,100 yield a benefit-cost ratio of 4.4.

It is expected that maintenance of the channel will be required every five years. Maintenance of the channel will be accomplished by the federal government as needed subject to the availability of maintenance funds. Maintenance of the entrance jetties will remain a local responsibility.

The Division Engineer recommends that subject to certain conditions of non-federal cooperation, the foregoing plan of improvement to Sesuit Harbor, Dennis, Massachusetts, be adopted. The presently estimated first cost to the United States is \$114,000. Non-federal interests will be required to pay \$114,000 as well as provide suitable disposal sites for dredged material for initial construction and subsequent project maintenance.

Revised January 1980

DETAILED PROJECT REPORT

THE STUDY AND REPORT

The waters surrounding Cape Cod offer one of the best cruising areas along the coast of New England. Boating enthusiasts come from all over the northeast to enjoy the facilities with which the Cape is richly endowed. However, on the north side of Cape Cod between the Cape Cod Canal on the west and Wellfleet Harbor on the outer arm of the Cape, there are only four small natural harbors where recreational boats can be launched or moored with relative ease and safety. One of these is Sesuit Harbor, located mid-way along the north shore.

PURPOSE AND AUTHORITY

A detailed engineering and economic study has been made to determine the need and justification for constructing navigation improvements in Sesuit Harbor in the town of Dennis, Massachusetts. This Detailed Project Report was authorized and submitted under the general authority contained in Section 107 of the 1960 River and Harbor Act as amended. Specific authority and funds were provided to conduct a feasibility study for navigation improvements by 1st Indorsement dated 16 June 1972, in reply to a letter dated 12 May 1972, from

the Division Engineer, New England Subject: "Sesuit Harbor, Dennis, Massachusetts."

SCOPE OF STUDY

In preparing this detailed project report, investigations were made of the immediate, future, local and regional needs for improvement of recreational boating navigation facilities. The study included environmental, economic and social considerations, selection of the most feasible plan and coordination with concerned agencies and private interests. All studies were made in the depth and detail required to permit optimum plan selection and to determine its feasibility.

STUDY PARTICIPANTS AND COORDINATION

The advisability of making navigation improvements at Sesuit Harbor necessitated close coordination between the Corps of Engineers and other federal, state and municipal agencies as well as local associations and individuals. Coordination was initiated by holding a meeting with the Dennis Board of Selectmen and the Sesuit Harbor Improvement Committee on 22 May 1969 to obtain information concerning the needs and desires for improvement. Since the desired improvements were clearly defined and all parties were in agreement that these improvements reflected the need and desires of local interests, it was decided that a public hearing was not necessary to initiate the study. A preliminary reconnaissance study was based upon information presented by local officials and data readily available to the Corps. The preliminary studies indicated that navigation improvements were feasible and economically justified.

A meeting was held with local officials on 19 February 1970 to discuss the results of the studies and the requirements of local cooperation. The selectmen of the town of Dennis stated that, while the proposed improvement would meet the needs of boating interests, it would be necessary to bring the proposal to a vote by the town. Results of the voting indicated that no further improvement of the harbor should be accomplished at that time. This situation was confirmed by a letter from the Board of Selectmen of Dennis dated 30 March 1970. In view of the inability of local interests to meet the requirements of local cooperation, the reconnaissance report was submitted on 13 April 1970

to the Chief of Engineers with the recommendation that no further study of Sesuit Harbor be made.

Subsequent to submission of the above report, the town of Dennis indicated that the original intent of requesting a federal study of Sesuit Harbor was to develop a project in a piecemeal manner to keep the local cost share down within the scope of available funds. They did not realize that a federal project would be designed to satisfy the needs of the harbor for a period of 50 years and would have to be constructed in one step to the full extent required. As it turned out, the proposed improvement which was defeated by town vote had nothing to do with the federal project study. The federal plan of improvement was never placed on the town warrant in March 1970. The town was looking toward slow orderly development of the harbor in phases, by first clearing the entrance channel with federal participation, then expanding the inner harbor mooring facilities as needed. Early in 1972 the Board of Selectmen requested the Corps of Engineers to resume the improvement study in greater detail. A meeting was held with town officials on 25 April 1972 to discuss reactivation of the federal study. At that time, a revised preliminary plan of improvement was presented to the town officials. Preliminary costs of the revised plan of improvement indicated that a more detailed study was warranted.

Workshop meetings have been held with local interests culminating in a final stage public meeting held on 29 November 1977 where findings of this study were presented to the general public and a selected plan of improvement was recommended. A draft environmental assessment has been coordinated with all affected federal, state and local interests. A revised environmental assessment with review comments will be forwarded with this report to the Chief of Engineers, Washington, D.C. Appendix 2 contains pertinent correspondence exchanged among participants during the study period.

THE REPORT

This report is a Detailed Project Report, the contents of which are organized into a main report and four appendices. The main report is a brief, non-technical presentation, with recommendations, on the need for and advisability of providing entrance channel improvements in Sesuit Harbor. Appendix 1 is a detailed technical report following the same general format as the main report containing maps,

photographs, tables and charts pertaining to the study. Appendices 2 and 3 are the environmental and socioeconomic effects assessments of the proposed plan. Appendix 4 contains pertinent correspondence pertaining to the project.

PRIOR STUDIES AND REPORTS

There is no federal navigation project at Sesuit Harbor. An unfavorable survey report, submitted in 1959, considered overall improvement of the harbor to accommodate recreational boats. The survey report found that state and local interests had improved Sesuit Harbor sufficiently for the needs of present and prospective boating interests. The Division Engineer concluded that federal participation in a project for navigational improvement was not necessary at that time.

During the period 1949 to 1958, the Commonwealth of Massachusetts constructed stone revetment, along both shores of the harbor and two stone jetties at the entrance. The state also dredged an entrance channel and a 4-acre outer anchorage to a depth of approximately 8 feet deep below mean low water; a 7-acre inner anchorage 6 feet deep, connected to the outer harbor channel by an 80-foot wide channel 6 feet deep. In 1976, the state performed emergency maintenance dredging in the entrance channel to a depth of 6 feet over a width of 60 feet to restore access to the inner harbor. Approximately 21,500 cubic yards of material was removed and deposited on the beach east of the harbor entrance.

RESOURCES AND ECONOMY OF STUDY AREA

To a large degree, the resources of a region determine the status of its well-being and growth potential. A general understanding of these resources and development trends is helpful in identifying regional problems and needs in order to select appropriate solutions. Sesuit Harbor is ideally situated to serve as a center for recreational boating activities along the north shore of Cape Cod. The upgrading of boating facilities is essential, if the region is to benefit from the water resources available.

Sesuit Harbor is located on the north side of Cape Cod, in the town of Dennis, about five miles eastward of Barnstable Harbor and about eight miles southwest of Wellfleet Harbor. The harbor forms the mouth of Sesuit Creek, a narrow winding stream which drains a 165 acre salt marsh area extending south and west of the harbor entrance. The adjacent shoreline both east and west of the entrance consists of moderately wide sandy beaches interspersed with boulders and bedrock outcrops. These beaches are used by local residents for recreational bathing.

Sesuit Harbor is about 3,500 feet long with controlling depths ranging from 2 to 8 feet in the dredged portions. The mean tide range is 9.5 feet and the spring range is 11.0 feet. During severe winter conditions the harbor is iced in for periods of 1 to 2 months. The climate of the area is temperate, with temperatures ranging from a mean of 31.7°F. in January to 71.1°F. in July. Mean annual precipitation, mostly in the form of rain, is 40.58 inches.

The town of Dennis is located about mid-way across the southern arm of Cape Cod. It is about 85 miles from Boston, Massachusetts and 260 miles from New York City. The coastal areas of Dennis are dominated by marsh land fronted by barrier beaches. The interior is almost entirely sandy loam covered with thin strands of hardwood timber and brush. The land formations are comparatively level with maximum elevations of not more than 100 feet running along low hills on the north coast. There are several small ponds in the hilly area and larger ponds in the south. The town has a tidal shoreline of 29.8 miles.

A good network of paved roads serves the area. The principal highways are State Routes #28, 134, 6 and 6A leading to the mainland across the Cape Cod Canal. Two bus lines serve the town. Hyannis Municipal Airport in the nearby town of Barnstable provides scheduled air flights.

HUMAN RESOURCES

Barnstable County which includes the town of Dennis is a rapidly growing vacation spot, known far and wide for its magnificent beaches, stately homes, and art colonies. During the decade 1960 to 1970, the population of the county increased by 26,370 or 37.5% while the population of Dennis increased 2,727 or 73.2%. The median age of Dennis residents is 44.3 years and the median per capita income is \$3,618. The total population of the town according to the 1970

census was 6,454 people representing an increase of nearly 300 percent since 1930. Of the 4,874 persons over 16 years old in Dennis, 2,117 or 43.4% were in the civilian labor force.

DEVELOPMENT AND ECONOMY

Dennis was settled about 1639 as part of the town of Yarmouth. The town was incorporated in 1794. Historically the area has seen constant changes in major industries. Shipbuilding, fishing, cranberry growing and salt works were the mainstays of the economy during the last century. Starting in 1890, following improvement of transportation, the area became a resort. Today, as in most Cape Cod communities, the main economic interest is centered around the attraction of summer tourists and residents. The wholesale and retail industry is the principal industry of the town, accounting for 52% of the annual payroll and 56.3% of the average employment. The second principal industry is the construction business reporting 23.3% of the annual payroll and 16% of the average employment.

PROBLEMS AND NEEDS

Historically the north side of Cape Cod has served as the home base of small commercial fishing fleets which operate in the nearby off-shore fishing grounds. Due to shoals at the entrance to Sesuit Harbor, it has not received the commercial fishing use experienced by deeper draft harbors such as Provincetown and Wellfleet. Commercial fishermen find it difficult to use the harbor not only because of shoals but also due to a lack of onshore facilities for handling and storage. All bait and tackle has to be hauled to and from the landing areas daily by the local fishermen. As a result, they usually land their catch at other harbors. The permanently based fishing fleet consists of one small dragger and 12 lobster boats. Six charter fishing boats operate from the harbor during the summer.

However, Sesuit Harbor, along with most harbors on Cape Cod, has become crowded with recreational craft. The recreational boating boom has nearly exhausted available mooring spaces. There are several sites within Sesuit Harbor which could be developed to relieve the crowded conditions provided a safe and adequate entrance channel to the harbor is developed and maintained.

STATUS OF EXISTING PLANS AND IMPROVEMENTS

The Commonwealth of Massachusetts improved the harbor by construction of stone revetment along the west and east banks of Sesuit Creek and stone jetties at the entrance. The west jetty is 1,000 feet long and the east jetty is 1,130 feet long. Both jetties were constructed with a top elevation of 14 feet above mean low water. There is one privately owned marina offering dry storage areas for storage of 245 boats, with wet berths and moorings for 41 boats. There are four float landings in the harbor, two owned by the town of Dennis, one by the Sesuit Harbor Marine Service, 120 feet long by 8 feet wide and one owned by the Dennis Yacht Club. On either side of the harbor there are boat launching ramps. The west side ramp is maintained by the town and the east side ramp by the state. There are parking areas for cars and boat trailers which are filled to capacity on weekends during the summer boating season. These facilities have greatly increased the transient boating use of the harbor. The town of Dennis owns most of the land immediately surrounding the improved portion of the harbor and has under consideration the purchase of the additional land adjacent to the inner basin. The Dennis Yacht Club has a small fleet of sailing craft moored in the outer harbor on the west side just inside the entrance. Gas, water and marine supplies are available at Sesuit Marine Service.

NEEDS FOR CHANNEL MODIFICATIONS

The recreational boat operators using Sesuit Harbor are experiencing navigation difficulties in negotiating the existing entrance channel to Sesuit Harbor. Shoaling of the channel results in tidal delays. Damages have been sustained from grounding during passage under adverse weather conditions. The town has tried to maintain the entrance channel which shoals to about two feet below mean low water, thus preventing the larger craft from entering or leaving during a two-hour period before and after low tide. Extending and widening the channel would provide safer navigation resulting in lower operating costs. A deeper channel would open the harbor to use as a harbor of refuge for small craft cruising in the lower reaches of Cape Cod Bay. These craft by-pass the harbor under existing conditions due to the dangerous shoals in the entrance.

IMPROVEMENTS DESIRED

Local interests desire to improve Sesuit Harbor in the interest of small boat navigation. Charter boat operators and other waterfront interests state that the harbor has excellent sheltering characteristics and contains enough area to meet the needs of recreational boating provided a stabilized entrance channel 6 to 8 feet deep could be maintained. Further development of boating facilities within the harbor is entirely dependent upon access to open water of Cape Cod Bay.

FORMULATING A PLAN

A plan was formulated after establishing alternatives that would provide solutions to navigation problems at Sesuit Harbor. Several alternatives were evaluated, giving consideration to economic, environmental and social factors included in the planning objectives.

FORMULATION AND EVALUATION CRITERIA

An analysis of all factors affecting project formulation was made. The analysis was based on the need to make full use of water and land resources and to improve the quality of life through contributions to the objectives of national economic development and environmental quality, as set forth in the Water Resources Council's Principles and Standards for Planning Water and Related Land Resources. The analysis of alternatives considers a National Economic Development Plan and an Environmental Quality Plan. Formulation of a plan of improvement could result in one of these plans or a combination of the two being selected. Selection of a specific plan for Sesuit Harbor is based on technical, economic and environmental criteria which would permit a fair and objective appraisal of the consequences and feasibility of alternative solutions. The alternatives are based on continued harbor growth with land facilities available to accommodate increased water based activities provided by a local public agency willing to implement expansion, development and renovation.

Technical criteria requires the selected plan to be consistent with local, regional and state plans for land use and harbor development. The optimum plan should have dimensions adequate to accommodate expected user vessels and have sufficient land available for full development of water resources. Adequate access and utilities should

be available to allow future growth. Any utilities crossing the site should provide safe clearances for expected user vessels and vehicles.

Economic criteria specifies that benefits for a water resource project should exceed costs. The analysis also must determine the point where benefits exceed costs. The selected plan should not preclude development of a more economical plan. The costs of all alternative plans of development should be based on current prices, a 50-year life period of economic analysis, and include an interest rate of 6 7/8 percent. The plan resulting from application of the foregoing economic criteria provides a baseline for considering other factors which cannot be quantified in economic terms, but which may warrant modifications of the plan.

Environmental criteria involve identifying forms of marine and terrestrial life which might be endangered by a plan's implementation, minimizing adverse environmental impact, and avoiding plans with severe social consequences. Measures to protect or enhance existing environmental values should be a part of the selected plan. Activities related to the selected plan must be compatible with those in the surrounding areas. The selected plan should be coordinated with appropriate agencies, groups and individuals.

POSSIBLE SOLUTIONS

To satisfy the needs for improved boating facilities at Sesuit Harbor, navigation hazards must be eliminated. There are two possible solutions available to solve this problem:

1. Relocate the existing facilities to another site.
2. Develop new facilities.

The development of new facilities in the mid-cape area would relieve congestion problems within Sesuit Harbor. Development would have to occur at some other site outside Sesuit Harbor due to geographical limitations. Development of piers, repair yards, storage areas, parking facilities and access roads would be needed to relieve congestion. Construction costs for developing new areas, however, would be prohibitive. Additional dredging and shore protection structures would be required and an extensive maintenance

program would have to be instituted. Local investment would be prohibitive since new construction of piers, service facilities and transportation routes would be required. Land taking would be necessary in lands now devoted to other forms of development or conservation. This alternative is therefore rejected. Modification of existing facilities was the second alternative considered. Since there are adequate berthing, handling and storage facilities already available at Sesuit Harbor and land access routes serving these facilities are adequate, the problem simplifies to a case of modifying the existing navigation channel to provide optimum access to these facilities. By converting existing mooring areas into additional marina facilities, more craft can be accommodated making maximum use of the harbor. Originally, local interests planned to construct a marina at the upper end of the marsh adjacent to Sesuit Neck Road with a connecting channel to the inner harbor basin. This location was considered because it would be within walking distance to a local shopping center. However, due to excess costs, they decided to enlarge the inner basin to accommodate additional boats. Additional area to expand is available within the confines of the harbor. Further study of this type of alternative to relieve crowded conditions is indicated.

Another alternative would be the "no improvement" or status quo alternative. This would not serve as a solution to current problems as the harbor entrance would continue to remain shoaled forcing abandonment of investments in existing facilities.

ALTERNATIVES CONSIDERED FURTHER

Discussion of alternatives, thus far, has been based on the premise that there is a need for expansion in Sesuit Harbor in order to relieve congestion at existing facilities. Expansion to areas outside Sesuit Harbor is out of the question as it would require prohibitive local investment costs. A "no improvement" alternative would eventually result in loss of existing facilities and would prevent the logical steps of an orderly development and growth of the valuable recreational boating industry.

Construction and maintenance of an adequate entrance channel is the only feasible and economically justified alternative to eliminate tidal delays and damage to boats. This improvement would permit development and growth of the harbor to keep pace with future needs.

As part of the study of dredging improvements, investigation of material disposal methods was also necessary. Because of the abundance of residential land, wildlife preserves, and marshlands in the local area, a disposal site would have to be capable of complete restoration to its original state in order to minimize adverse impacts usually associated with disposal of dredged material. Disposal on the beach west or east of the harbor entrance and disposal at sea were considered as alternatives. Selection of a beach disposal site best fulfills the economic, environmental, and social criteria used during the course of the investigation.

SELECTING A PLAN

Since the major problem at Sesuit Harbor is the shoaled entrance, adequate deepening is the only means of improvement. Removal of this shoal would provide access to the harbor facilities. This alternative would maximize benefits under the National Economic Development Plan. The Environmental Quality Plan alternative would also be realized as shoreline management programs are committed to full development of existing ports while preserving other areas for recreational uses or natural preserves. The Environmental Quality Plan would be full development of existing facilities with minimization of adverse environmental impacts.

THE SELECTED PLAN

This section presents an overall view of the selected plan and its effects. The design, construction, operation and maintenance aspects of the plan are also discussed. Benefits commensurate with National Economic Development criteria and Environmental Quality criteria resulted in choosing the same alternative, which is presented as the selected plan.

PLAN OF IMPROVEMENT

A plan of improvement has been developed which represents essentially the desires of local interests. The plan of improvement selected would provide for:

A channel, 6 feet deep below mean low water, 100 feet wide from deep water in Cape Cod Bay to a point opposite the Dennis Yacht Club thence reducing in width to 80 feet at the entrance to the inner harbor basin, for a total channel length of 2,400 feet. Approximately 40,000 cubic yards of fine to medium sand would be removed from the channel by hydraulic methods. The sand would be deposited on the beach westward of the channel entrance. The plan is shown on plate 1.

The proposed plan of improvement would provide a safe entrance channel to the harbor and also provide the opportunity to expand the existing harbor facilities consistent with town needs.

Other benefits will accrue to local interests. The dredged materials will improve the bathing facilities on the beach, reduce erosion and provide a source of needed fill materials for local town use. Annual benefits resulting to the recreational boating interests for the 50-year project life due to increased efficiency of operation are estimated at \$197,300.

EFFECTS ON THE ENVIRONMENT

Dredging the channel and disposal of sand on the beach west of the harbor entrance will affect both marine and terrestrial organisms. Removal of material will reduce the number of bottom dwelling organisms which cannot evacuate the dredged area. Mobile organisms would avoid the area during dredging operations. Levels of dissolved oxygen and turbidity in the waters would be affected by dredging and disposal. Short-term increases in turbidity would result from suspended sediments stirred up by the dredge but not to the extent experienced by normal wave action under storm conditions. Turbidity will result on the beach when particles are re-introduced into the beachfront from the disposal effluent. Dissolved oxygen levels would be temporarily suppressed as organic sediments require dissolved oxygen for bacterial decomposition. Concentrations of potentially toxic heavy metals are not present in quantity to have an effect on resident or migratory biota. Dredging

operations would be scheduled during the seasons of minimum waterway use by marine biota and recreational boating activities. The dredged material would be spread on the beach to reduce erosion of the shoreline in this area. Littoral drift will move the material along the shore away from the harbor providing a source of material to alleviate starvation of the beach. After one winter season the dredged material will be sorted out by wave action to form a suitable bathing environment.

Fuel emissions within the harbor from vessels will increase as the fleet expands in size whether or not the project is accomplished. Opening of the present channel to a greater depth will help to disperse any increased discharge of grease or oil contaminants keeping these pollutants to an acceptable level. Marine odors will be present during dredging operations. However, it is expected that these odors will be no worse than those experienced during normal low tide periods.

OTHER EFFECTS

The project will support economic growth since the lack of a channel improvement would eventually require development investments at some other site. Improvement at this site would provide additional monies accruing from the expansion of the fleet resulting in a larger tax base locally. Utilization of the dredged materials on the beachfront will upgrade the recreational area and provide needed beach erosion protection. Fuel usage and marine supply sales will increase following channel improvement.

DESIGN

The major design considerations in navigation channel improvements are those relating to dimensions (width and depth). Depth of water under the keels of vessels using the harbor should be sufficient for safe and efficient operation. The loaded draft, squat or sinkage, trim and maneuverability of a vessel as well as wave action, tidal fluctuations, and speed of the vessel were considered in selecting the appropriate channel depth. Channel width was based on the length of channel, orientation, maneuvering space requirements, and density of vessel traffic.

CONSTRUCTION

Assuming federal authorization and appropriation of construction funds as well as local cooperation financing, the dredging of the project would be accomplished in less than two months. A pipeline dredge would be used to accomplish the channel improvement. Disposal on the beach west of the harbor entrance would be controlled by construction of temporary sand dikes to reduce excessive movement of sand during dredging operations.

Dredging of the 40,000 cubic yards of material with disposal on the above described locations would cost \$228,000, at January 1978 prices including contingencies, engineering, design supervision and administration costs. Costs and benefits are discussed in detail in Appendix 1 of this report.

The economic justification of the proposed waterway deepening was determined by comparing the equivalent average annual benefits accruing to the project over its economic life. If the federal government is to contribute to the project, average annual benefits should equal or exceed the average annual costs. Benefits and costs are compared by putting them on an average annual basis at an interest rate applicable to public projects. All goods and services used in development of the project are estimated in monetary terms. Benefits are considered to be increased operating efficiencies and reduction of damages resulting from collision or grounding.

COSTS

The estimated first costs and annual charges of the selected plan, based on January 1978 prices are summarized in Table 1. The estimated annual costs are based on a 50-year economic life, with interest and amortization charges based on an interest rate of 6 7/8 percent. Annual charges include periodic maintenance dredging plus repairs to the east jetty extension. Investment cost equals first cost because the time frame required to accomplish construction is relatively short, less than one year.

TABLE 1
Project Cost Estimate

Channel Dredging 40,000 c.y. @ \$4.10/c.y.	\$164,000
Contingencies	25,000
Sub-total	<u>\$189,000</u>
Engineering and Design	17,000
Supervision and Administration	22,000
Total First Cost	\$228,000
Annual Charges:	
Interests & Amortization	16,300
Maintenance Dredging & Rock Jetties	28,800
Total Annual Charges	<u>\$45,100</u>

BENEFITS

Channel improvements to the entrance channel at Sesuit Harbor would permit boat owners to enjoy full use of their boats. The increased boat usage and fleet expansion resulting from the proposed channel are considered to be project benefits.

The dollar value is expressed in terms of an increase in annual net return on the value of the boat which might be expected if the boat were for hire.

Maintenance dredging to the authorized depth every four years would provide maximum use of the boating fleet throughout the project life.

Boats using Sesuit Harbor now and those expected to use it in the future were classified into five categories:

- A. Existing permanently based fleet
- B. Existing transient fleet
- C. New boats purchased immediately as a result of the project.
- D. Long term fleet growth (50 years)
- E. Transient fleet growth (50 years)

Each category and type of craft within each category was analyzed in terms of the current and annual return expected if the boat were for hire and the net annual return which could reasonably be expected after construction of the project.

JUSTIFICATION

A summary of the economic analysis is shown in Table 2, and indicates how the average annual benefits compare with the average annual costs for improvement of Sesuit Harbor. Only values that can be quantified are represented. The estimated annual costs and benefits and the ratio of benefits to costs indicate that the plan to improve the entrance channel is economically justified.

TABLE 2
Summary of Economic Analysis

Average Annual Benefits	\$198,100
Average Annual Costs	45,100
Benefit-to-Cost Ratio	4.4

DIVISION OF PLAN RESPONSIBILITIES

This section presents the division of plan responsibilities between federal and non-federal interests in connection with development of the proposed project.

FEDERAL RESPONSIBILITIES

The Corps of Engineers would design and prepare detailed plans and specifications, administer contracts relative to the project and supervise the channel dredging and disposal area containment structures. The federal government would assume fifty percent of the cost of dredging, amounting to an estimated \$114,000 and any pre-authorization study costs and would provide maintenance of the project as needed, subject to the availability of maintenance funds.

NON - FEDERAL RESPONSIBILITIES

Local interests would be responsible for fifty percent of the project construction costs, as well as the costs for constructing disposal dikes, spillway control structures and dredging of all berthing areas outside the limits of the federal project. Local interests would continue to maintain the entrance jetties. They would also be responsible for provision of necessary lands, easements, rights-of-way; any necessary vegetation of disposal areas and holding the United States free from damages due to construction and maintenance work. Local interests will perform the necessary dredging, construction and maintenance of additional berthing spaces as required for expansion of the project support facilities during the life of the project as well as establish regulations prohibiting disposal of pollutants into the waterway.

PLAN IMPLEMENTATION

The steps necessary to implement the navigation improvement for Sesuit Harbor as proposed herein, are as follows:

The draft Detailed Project Report and environmental assessment have been coordinated at regional, state and local levels. Comments are made part of this report. When the Division Engineer completes his review, he will transmit the report to the Office of the Chief of Engineers for review and authorization.

Upon approval, the project will take its place on the list of approved projects awaiting construction funds. When federal funds for construction become available local interests will be requested to sign formal agreements of local cooperation and will be requested to furnish the non-federal cost and share for construction. Pre-construction work consisting of plans and specifications will be completed with the final objective being to initiate construction and completion of the project. Design and completion of the project construction can be completed within one year if appropriations are forthcoming as needed.

Revised January 1980

REVIEW BY OTHER AGENCIES

The draft report and selected plan of improvement were coordinated with all concerned federal, state and local interests. At the federal level, the Environmental Protection Agency and the Department of Interior's Fish and Wildlife Service were asked to comment on the selected plan. At the state level, the Office of Coastal Zone Management acted as the coordinator for all concerned divisions within the Commonwealth of Massachusetts. The Town of Dennis, of course, was asked to comment on the selected plan as well as all other alternatives during the course of the study.

In general, comments received from all concerned interests supported channel modifications. Two points were raised by the U.S. Fish and Wildlife Service. The first point concerned expansion of the existing town marina facilities into sensitive marshland adjacent to the harbor. The second point concerned the future dredged material disposal sites for maintenance dredging. These concerns have been addressed in the final report.

Letters and reports containing comments, criticisms, recommendations, suggestions and all other pertinent correspondence are included as Appendix 4 in this report.

STATEMENT OF FINDINGS

As Division Engineer of the New England Division, Corps of Engineers, I have reviewed and evaluated in the overall public interest, all pertinent data concerning the proposed plan of improvement, as well as the stated views of other interested agencies and the concerned public relative to the various practical alternatives in providing navigation improvements in Sesuit Harbor, Dennis, Massachusetts.

The possible consequences of alternatives have been studied according to engineering feasibility, environmental impacts, economic factors of regional and national resource development and other considerations of social well-being in the public interest. The ramifications of these issues have been stated in detail in the formulation of this plan of improvement and in other sections of this report.

In summary there are substantial benefits to be derived by providing the recreational boaters using Sesuit Harbor with reliable access to the harbor at all stages of tide. The provision of a federal channel and the assumption of maintenance of the existing entrance jetties at Sesuit Harbor by the local government are the most feasible and economical improvements to be provided in Sesuit Harbor to support recreational navigation.

It is noted that the improvement would cause a minor disruption of the environment during dredging and disposal operations. Due to the significant benefits attributable to the recreational boating industry, it is considered that this adverse environmental effect would be more than offset by improvement in the overall economic growth of the region.

I find that the proposed action, as developed in this report, is based on a thorough analysis and evaluation of various practicable alternative courses of action for achieving the stated objective, that, wherever adverse effects are found to be involved, they cannot be avoided by following reasonable alternatives and still achieve the Congressionally specified purposes; that where the proposed action has an adverse effect, this effect is either ameliorated or substantially outweighed by other considerations. The recommended action is consistent with national policy, statutes, and administrative directives, and should best serve the interests of the general public.

RECOMMENDATION

The Division Engineer recommends that a federal navigation project at Sesuit Harbor, Dennis, Massachusetts be authorized by the Chief of Engineers under the provisions of Section 107 of the River and Harbor Act of 1960, as amended.

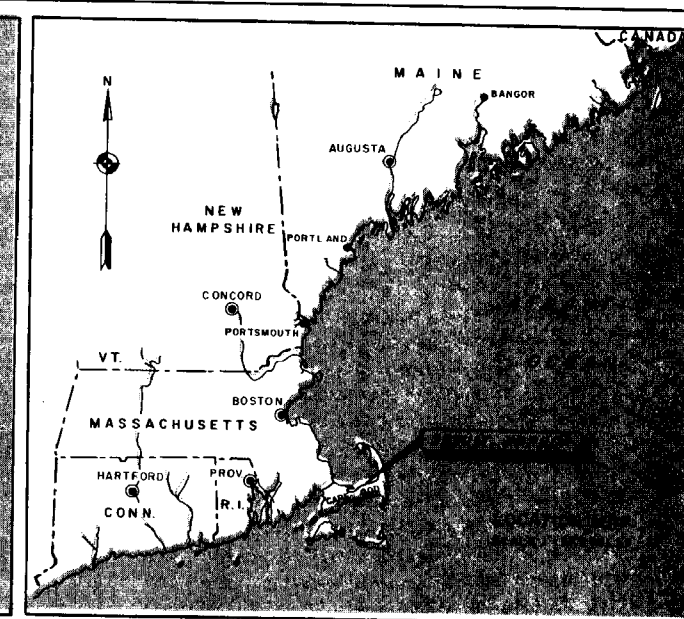
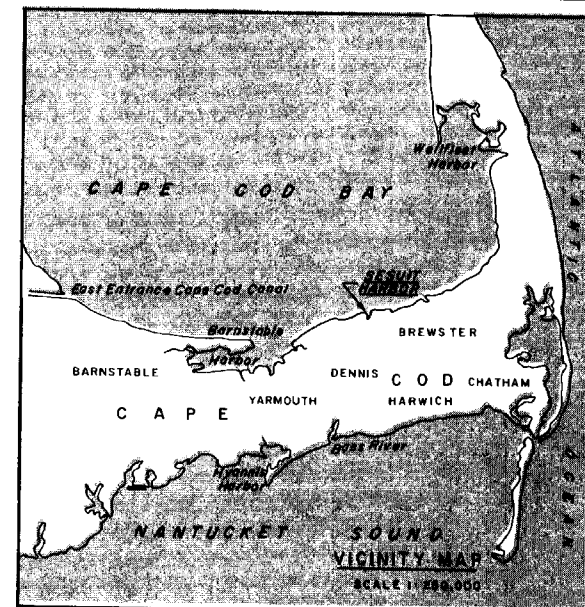
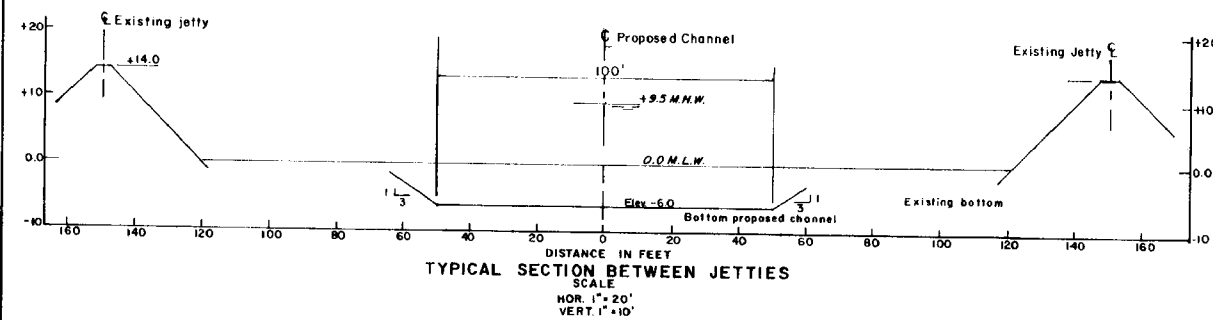
The project would provide a channel, 6 feet deep below mean low water, 100 feet wide from deep water in Cape Cod Bay reducing in width to 80 feet up to the marina facilities and boat launching ramps within the harbor--a total length of 2400 feet. The total project cost is estimated to be \$228,000 to be shared equally by the federal government and the Town of Dennis. Annual maintenance costs are estimated to be \$28,300 of which \$25,300, representing the annual cost of channel maintenance, is a federal responsibility. The recommendation is made subject to the conditions that local

interests will:

- Provide a cash contribution of 50 percent of the cost of construction, presently estimated to be \$114,000.
- Provide without cost to the United States all lands, easements, and rights-of-way necessary for the construction and subsequent maintenance of the federal channel, and land and necessary dikes and weirs for disposal of dredged material, or costs of such retaining works.
- Hold and save the United States free from damages that may result from construction and maintenance of the project.
- Maintain the entrance jetties.
- Maintain the existing public boat launching ramp and marina facilities open to all on equal terms.
- Establish regulations prohibiting discharge of untreated sewage, garbage, and other pollutants in the waters of the harbor by users thereof, which regulations shall be in accordance with applicable laws or regulations of federal, state and local authorities responsible for pollution prevention and control.

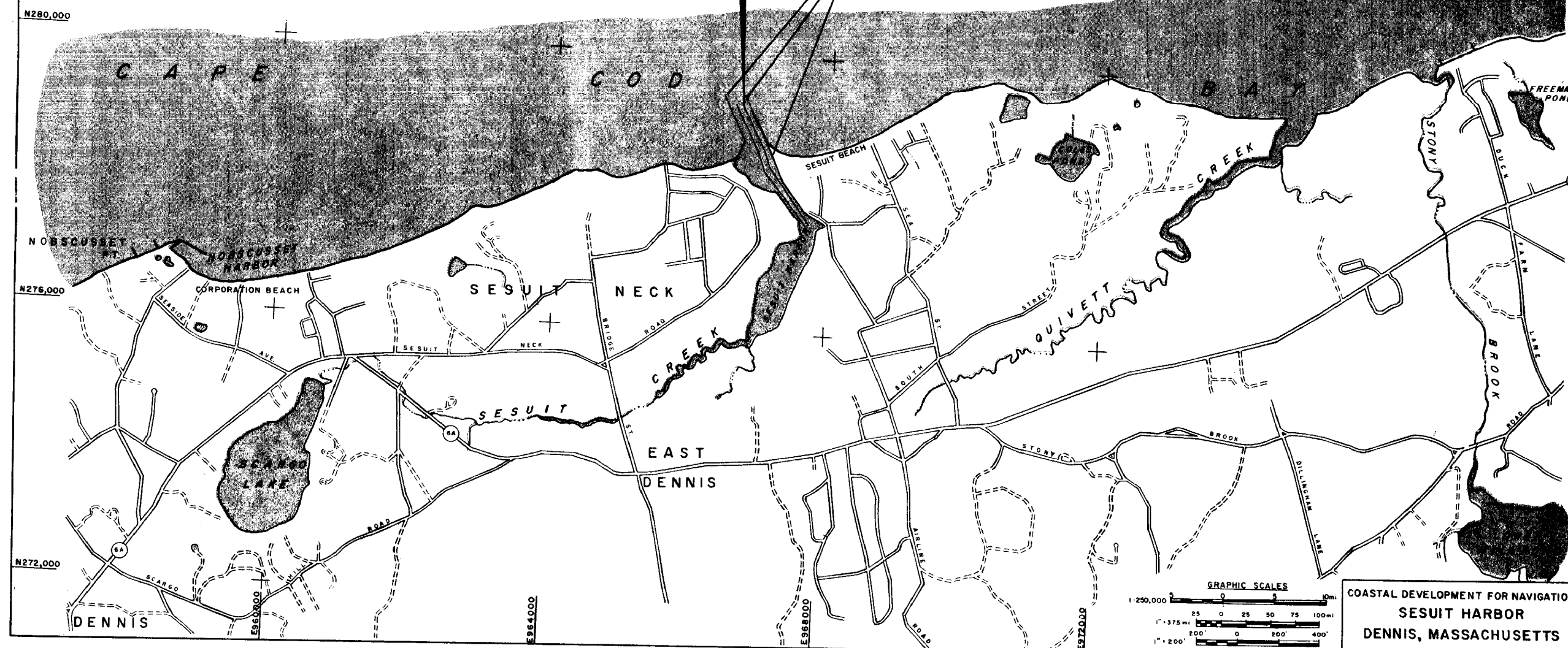
Max B. Scheider

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer



**CONSIDERED IMPROVEMENT
 RECOMMENDED**
 CHANNEL: 6' deep, 80' to 100' wide

**CONSIDERED IMPROVEMENT
 NOT RECOMMENDED**
 1. Extend West Jetty 350 feet
 2. Extend East Jetty 450 feet
 3. Raise Revetment to Elev +14.0 M.L.W.



**COASTAL DEVELOPMENT FOR NAVIGATION
 SESUIT HARBOR
 DENNIS, MASSACHUSETTS**

**SESUIT HARBOR
DENNIS, MASSACHUSETTS**

**DETAILED PROJECT REPORT
CHANNEL MODIFICATION FOR NAVIGATION**

TECHNICAL REPORT

APPENDIX I

**PREPARED BY THE
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION**

TECHNICAL REPORT

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SECTION A

THE STUDY AND REPORT

1. Information concerning this study and report is presented here. It serves as an introduction to the study and its findings, and their presentation in the report.

PURPOSE AND AUTHORITY

2. The purpose of this study, the results of which are presented in this technical appendix, is to determine if the need and justification for constructing navigation improvements in Sesuit Harbor, Dennis, Massachusetts, is in the best interest of the general public. Recommendations of the study are presented in the main report.

3. The study report is submitted under General Authority contained in Section 107 of the 1960 River and Harbor Act as amended. Specific authority was provided by 1st indorsement dated 16 June 1972 from the Chief of Engineers in reply to a letter dated 12 May 1972 from the Division Engineer, New England Division, Subject "Sesuit Harbor, Dennis, Massachusetts."

SCOPE OF THE STUDY

4. Sesuit Harbor has become a center of recreational boating activity on Cape Cod Bay but future growth would be inhibited without improvements for navigation. Local interests requested the Corps of Engineers to study alternative means of improving the harbor in the interest of navigation. Investigation was initiated by use of available maps, charts and aerial photographs. Questionnaires were sent to local interests to obtain data on the existing facilities as well as the type, size and number of boats using the harbor. The depth and detail of the study were commensurate with the objective of selecting the most suitable plan of development and determining its feasibility, giving consideration to economic, environmental and social factors. Additional data needed for the study was obtained from meetings with local interests. Conferences were held with local officials to discuss considered improvements and the attendant requirements of local cooperation.

STUDY PARTICIPATION AND COORDINATION

5. The navigation improvement study required close coordination between the Corps of Engineers and other involved interests. In order to accomplish this coordination, a number of fact finding workshops were held with federal, state, and local agencies and individuals. In addition to the Corps of Engineers, agencies represented were:

- Fish and Wildlife Service, U.S. Dept of Interior
- Environmental Protection Agency
- Town of Dennis, Board of Selectmen
- Town of Dennis, Conservation Committee
- Sesuit Harbor Study Committee
- Massachusetts Division of Waterways, Dept. of Environmental Quality Eng.
- Massachusetts Office of Coastal Zone Management
- Sesuit Harbor Marina
- Walter E. Rowley Assoc., Consulting Engineers

6. The Corps of Engineers was responsible for conducting and coordinating the study, consolidation of information from other agencies, formulation of a plan, and preparation of this report. Comments concerning the possible effects of channel improvement upon fisheries, recreational and environmental resources in the area are presented in Appendices 4 and 5. No initial public hearing was held as all local interests were in accord with the needs for channel improvement. A public meeting was held on 29 November 1977 during which a summary of the study and the recommended improvements were presented for review and comments.

THE REPORT

7. This report has been arranged into a non-technical main report and four appendices.

8. The main report presents the regional problems, needs and effects associated with improving Sesuit Harbor navigation facilities. It presents a broad view of the overall study for the benefit of both general and technical readers. Included are a description of the study area and the present status of conditions; selection of a plan for meeting the needs; description of the selected plan; a summary of the project economics indicating the benefits, costs, and justification; division of responsibility between federal and non-federal interests; coordination information and recommendations for implementing construction of the selected plan.

9. Appendix 1 is a technical presentation following the same general format as the main report, but in greater detail. Appendices 2 and 3 are the environmental and socio economic effects assessments of the proposed plan. Appendix 4 includes pertinent correspondence pertaining to the project and Appendix 5 contains reports of other agencies.

PRIOR STUDIES AND REPORTS

12. Sesuit Harbor was the subject of a preliminary examination and survey to construct a channel basin and other improvements under authority of Section 110 of the River and Harbor Act approved 17 May 1950. The Division Engineer found that local interests had improved the harbor sufficiently for the needs of present and prospective boating and as a result federal participation in a project to further improve the harbor was not necessary at that time. Local officials concurred with the Division Engineer's findings.

SECTION B

RESOURCES AND ECONOMY OF THE STUDY AREA

1. To a large degree, the resources of a region determine the status of its well-being and growth potential. A general understanding of these resources and development trends is helpful in identifying regional needs and selecting appropriate solutions to problems encountered. The following pages discuss the resources of the study area as well as the development and economy of this region.

ENVIRONMENTAL SETTING AND NATURAL RESOURCES

2. Sesuit Harbor is located on the north shore of Dennis in Barnstable County, about 85 miles southeast of Boston, Massachusetts. The town of Dennis is bordered on the north by Cape Cod Bay, Brewster and Harwich on the east, Nantucket Sound on the south and Yarmouth on the west. Land area within the town is 20.66 square miles and has a tidal shoreline of 29.8 miles.

3. The town of Dennis contains most of the natural resources typical of Cape Cod. The most significant and noteworthy are the protected waterways leading to Cape Cod Bay and Nantucket Sound used by recreational craft and fishing vessels. Other significant resources include beach areas along Cape Cod Bay and Nantucket Sound. Salt marsh areas serve as a sanctuary habitat for animals, water fowl and other species. The estuarine and tidal waters contain numerous species of shellfish and finfish. The marshlands support flora such as marsh-weed, alder, seaside goldenrod, bulrush, cordgrass and other grasses.

TERRAIN AND LAND USE

4. The existing land form is primarily from glacial action, which deposited debris of sand, clay and boulders resulting in two major land types, the moraine and the outwash plain. The moraines consist of a low line of hills from 50 to 100 feet high above sea level extending across the town in an east-west direction close and parallel to Cape Cod Bay. The outwash plain spreads down from the moraines forming a narrow, constricted bank between the moraine and Cape Cod Bay and a broad sweeping stretch towards Nantucket Sound to the south. Water is commonly available and sewage disposal is easily accomplished because of the high filtration rate of the soil. Shallow water depths of less than eight feet fringe the beaches along both sides of the entrance to Sesuit Harbor gradually deepening to more than 30 feet immediately offshore in Cape Cod Bay. Sesuit Creek flows through a saltwater marsh forming the upper boundary of the harbor. This marsh is relatively low in elevation and subject to flooding during spring tide ranges. Cranberry bogs are scattered along the north shore of Dennis serving as a source of supplementary income for the year-round residents.

5. Along the shoreline in the vicinity of Sesuit Harbor the pace of development and usage has been and continues to be intense. There remains very little vacant land suitable for development. The shore areas have been developed for year-round residences and seasonal homes, camps, boat yards and marinas. Adjacent to the east side of the Harbor, sand dunes form the backshore of a public bathing beach with a paved parking area for beach use. These dunes are somewhat tenuously stabilized with vegetation on their slopes. Heavy use or disturbance can upset the environmental balance. Once disturbed they can only be restored with difficulty and by closing the area entirely to public use.

6. In general, the area surrounding Sesuit Harbor has had over 300 years of development with the major portion of construction occurring as year-round residences and summer homes. The harbor is naturally the focus of all development and has become the dominant force in establishing the unique character of this portion of East Dennis. During the first half of the 19th Century the harbor served as a construction site for eight clipper ships and four schooners. At present there is one privately owned marina. Four float landings are located in the harbor, two owned by the town of Dennis, one by the marina and one by the Dennis Yacht Club. The state has constructed a paved boat launching ramp on the east side of the harbor while the town owns and operates another ramp on the harbor's west side. The ramps have parking areas able to accommodate a total of about 200 cars and trailers. The facilities

are filled to capacity on summer weekends and have greatly increased the transient use of the harbor. The town of Dennis owns most of the land immediately surrounding the dredged portion of the harbor.

CLIMATE

7. The climate of the region reflects its relationship with the surrounding ocean waters. The mean normal temperatures in January are 31.7°F and in July 71.1°F . The mean annual temperature is 42° , 14°F less than the mainland state-wide range. Mean annual precipitation, which consists mostly of rainfall, is about 40.3 inches. The harbor is iced in during severe winter weather. Occasionally, tropical origin hurricanes pass over the area. The six hurricanes which caused the greatest tidal flooding along the south coast of Dennis listed in order of magnitude by year of occurrence were 1638, 1938, 1954, 1915, 1944 and 1960, respectively. Although the tidal flooding from these hurricanes ranged up to 13 feet above mean low water along the southwest, tidal flooding was not as high in Sesuit Harbor as that experienced from northeast storms due to the higher surges of tide resulting from the latter. North of Cape Cod winter storms cause tidal flooding with levels about 3 feet higher than a spring tide.

ADJOINING WATER COURSES

8. Cape Cod Bay forms the southern extension of Massachusetts Bay. The east entrance to the Cape Cod Canal enters the Bay from the west providing access to waters of Buzzards Bay and Long Island Sound. Access to all large ports in New England is readily available by these sea routes. Cape Cod Bay is chilled by the Labrador Current, making the waters somewhat colder for swimming than the south shore of Nantucket Sound which is warmed by the Gulf Stream flowing northward along the Atlantic Coast as far as Cape Cod before it veers out to sea. Both the Bay and Sound have relatively calm waters conducive to small boat activities.

HISTORICAL - ARCHEOLOGICAL FEATURES

9. The Cape Cod area is endowed with many varied points of historical and archeological interest dating back to pre-colonial days. The immediate Sesuit Harbor area contains no historical sites that are listed in the 1975 National Register of Historic Places. However, there is a marker on the west shore of the harbor commemorating the early shipbuilding site. An Indian burial site is located about one and one-half miles west of Sesuit Harbor. In view of the fact that the proposed improvement would only involve an area previously dredged there is no archeological significance attached to the work.

HUMAN RESOURCES

10. Seasonal residences, water-based recreational and commercial activity profile the principal land uses at Sesuit Harbor. During the 1960-1970 decade, the population of Dennis increased 73.2% while the population of Barnstable County expanded by 37.5%.

Table B-1 POPULATION-BARNSTABLE COUNTY
1960-1970

Jurisdictions	Total Population		Average Annual Change 1960-1970	
	1960	1970	Number	% Change
Barnstable	13,465	19,842	6377	47.4
Bourne	14,011	12,636	-1375	-9.8
Brewster	1,236	1,790	554	44.8
Chatham	3,273	4,554	1281	39.1
Dennis	3,727	6,454	1,727	73.2
Eastham	1,200	2,043	843	70.2
Falmouth	13,037	15,942	2,905	22.3
Harwich	3,747	5,892	2,145	57.2
Mashpee	867	1,288	421	48.6
Orleans	2,342	3,055	713	30.4
Provincetown	3,389	2,911	478	-14.1
Sandwich	2,082	5,239	3,157	151.6
Truro	1,002	1,234	232	23.2
Wellfleet	1,404	1,743	339	24.1
Yarmouth	5,504	12,033	6,529	118.6
Total County	70,286	96,656		

Source: U.S. Census of Population 1960, 1970

Based on projections by the Massachusetts Department of Commerce, it is estimated that the population of Barnstable County will increase to 106,000 by the year 1980 with the Dennis population growing to some 7,500 by the same year.

11. The median age of Dennis inhabitants is 44.3 years compared to 34.2 for the County of Barnstable. Approximately 93 percent of the dwellings are single homes and 84 percent are owner-occupied averaging 2.2 persons per dwelling, comparable to the average for the rest of Cape Cod. Approximately 70 percent of the homes in the town were built since 1950.

MAJOR SKILLS AND OCCUPATIONS

12. Of the 4,874 persons within the age bracket for employment in Dennis, 2117 or 43.4 percent were in the civilian labor force employed in wholesale and retail trades, construction and service industries.

DEVELOPMENT AND ECONOMY

13. Because of the absence of a manufacturing or industrial economic base or in fact any large source of locally generated income, permanent residents are primarily dependent upon the attraction of summer tourists through service activities. Somewhat over half of the residents were dependent on services in 1960 and by 1980 the proportion is expected to rise to two-thirds. In addition to the year-round residents engaged in service activities an estimated 6,000 college students, people who work in the South during the winter, proprietors of seasonal establishments and others come to the Cape each summer to work in service establishments.

14. The Cape is not in a competitive position in manufacturing with the concentrated labor markets of the larger mainland cities and towns. Most of the workers in manufacturing are employed in printing, boat building and candlemaking. The peak of manufacturing employment on the Cape is in the late fall, the result of the Christmas candle trade.

15. A special study of the fishing resources of the Cape was made by the Massachusetts Department of Natural Resources. The study showed that the total value of fishery products aggregated \$3.4 million in 1961. Since 1900 total production has declined by one-half. Lobster fishing has remained stable during the last decade. However, most fishermen are employed part-time. This trend toward part-time fishing is expected to increase as population increases, particularly in the lobster and shellfish industries.

16. The economy of the region is typical of most resort areas and characterizes the commercial activity. The summer season, so important to Cape Cod, lasts only three months, extending from mid-June through Labor Day. The ten-or twelve-week season results in low wages in a service economy. Continuous effort is being made to increase diversification of income sources and extension of the tourist season to raise the prosperity of Cape Cod and reduce the problem of seasonal unemployment. Heavy industry is incompatible with the resort area economy. Light industries could be attracted provided that the manufactured products would be used on the Cape. Since recreational boating is the number one participation sport in the area many experts believe that boat building would supply part of the diversification. A boat yard itself is a visitor attraction.

WATERWAY IMPROVEMENTS

17. There is no existing federal navigation project in Sesuit Harbor. The nearest federally improved harbor is at Wellfleet, 14 miles to the northeast. This harbor has an entrance channel and a nine-acre anchorage dredged to a depth of 10 feet. It was constructed in 1946. The town, county and state have spent considerable sums to provide permanent improvements in Sesuit Harbor. Prior to 1958, improvement of the harbor consisted of revetment and breakwater construction together with some dredging of the entrance channel and a small anchorage basin. The breakwaters were extended incrementally over a period of time with a view toward maintaining the entrance channel by scouring action while providing storm protection to the entrance. The anticipated scouring action of the entrance channel did not materialize. Consequently the entrance shoaled very rapidly. To obviate further shoaling and to enlarge the harbor sufficiently for prospective boating the state of Massachusetts in conjunction with local interests in 1958, extended both breakwaters to the 6-foot depth contour and placed riprap revetment on the west bank of the harbor for a distance of 600 feet. The entrance channel was dredged to 8 feet below mean low water, to a point opposite the inner end of the east jetty. A four-acre

anchorage basin 8 feet deep was dredged in the outer harbor and a second anchorage basin 6 feet deep, 7 acres in area was also provided, 700 feet upstream of the first basin. The total costs for work accomplished since 1945 were \$881,840 of which, \$673,000 was expended for the improvements made in 1958.

WATERFRONT DEVELOPMENT

18. Sesuit Harbor has been consistently filled to capacity with recreational boats and a few small lobster boats despite the constant shoaling of the entrance channel. The town has a boat ramp, piers with floats, and a parking area for about 100 cars and trailers on the west side of the harbor. In 1969 the State Access Board installed a 40 foot boat launching ramp with pier and float, and a parking area for about 80 cars with trailers on the east side of the harbor, which is filled to capacity on weekends and holidays. These facilities have greatly increased the transient use of the harbor.

19. Sesuit Marine Service Inc., a private marina has developed spaces for about 50 boats at floats and has a dry storage area for about 245 boats. The marina was given permission in 1975 to dredge approximately 10,700 c.y. of sand from the berthing area. The dredged material was placed on the adjacent town parking lot on the west side of the harbor. The remainder of the work consisted of construction of a concrete bulkhead, placing floats and piles for berthing of small craft.

20. Due to crowded conditions in the inner basin anchorage the town of Dennis developed plans to change the open anchorage into a marina in order to increase the capacity from 88 boats to 280 through the installation of float slips. Although a small number of lobster and finfish boats operate out of Sesuit Harbor, local fishermen do not have any facilities on shore to store bait and equipment. All supplies are trucked to and from residences. As a result most fishermen land their catch at other locations and do not utilize the harbor for commercial operations.

SECTION C

PROBLEMS AND NEEDS

1. This section of Appendix 1 discusses problems and needs which are existing to prevent full utilization of the harbor. The improvements desired by local interests are presented in this section.

2. The economy of the area is closely tied to water oriented activities to provide employment. Sesuit Harbor is the only location on the south side of Cape Cod Bay between the Cape Cod Canal and Wellfleet, a distance of 32 miles, where a harbor of refuge could be developed within reasonable costs. Most of the harbors on the bayside are shallow, half-tide access across the flats, navigable at high tide only.

3. In view of the extent of work and expenditures made by the state and local interests in improvements at Sesuit Harbor there is every indication that the harbor has potential to keep pace with the expansion of recreational boating activities on the Cape. Further expansion is contingent upon providing adequate access to the mooring areas.

NEED FOR IMPROVEMENT

4. The most urgently needed improvements are the provision of reliable access through the entrance channel followed by an organized method of incremental expansion of facilities to accommodate prospective fleet expansion. Vessels entering and leaving the harbor generally experience tidal delays or risk grounding while navigating through the entrance channel. Local interests, being aware that expansion of the berthing facilities is a local responsibility, limited their desires for federal participation in improvement to development of an adequate and safe entrance channel. They claim that once this could be established, expansion of the mooring facilities would be fully warranted and they would proceed with expansion of the inner harbor facilities as funds become available. The remainder of this study is concerned with alternative solutions to improve the channel including associated cost studies and determination of benefits.

SECTION D

FORMULATING A PLAN

1. Formulation of a plan of improvement for Sesuit Harbor to meet the navigation needs, incorporated the use of criteria adopted in accordance with the Water Resources Council (WRC) Principles and Standards and other related policies. Due consideration was given to economic, environmental and social factors included in the planning objectives.

FORMULATION AND EVALUATION CRITERIA

2. The formulation and evaluation of a plan of improvement for Sesuit Harbor, including the screening of alternatives, was predicated on a standard set of criteria adopted to permit the development and selection of a plan which responds to the problems and needs and which is justified. Each alternative was considered on the basis of its contribution to the planning objectives and enhancement of the four Principles and Standards Accounts of National Economic Development (NED), Environmental Quality (EQ), Regional Development (RD), and Social Well Being (SWB). State and local objectives were considered in developing the selected plan of improvement for Sesuit Harbor. These objectives were based on regional, state and local needs for improvement including disposal of dredged material.

TECHNICAL CRITERIA

3. The following technical criteria were adopted for use in formulating a plan:

- The selected plan should be consistent with local, regional and state goals for growth of the harbor boating activities.
- Dimensions (length, width and depth) of the channels should be adequate to accommodate expected user vessels for the foreseeable future.
- Adequate area should be available to accommodate the contemplated harbor improvements and for disposal of dredged material on shore.

ECONOMIC CRITERIA

4. The following economic criteria were applied in formulating a plan of improvement:

- Tangible benefits should exceed project costs.
- The scope of the improvement is such as to provide the maximum net benefits unless benefits are foregone or additional costs are incurred to serve the environmental quality objective.
- There is no more economical means, evaluated on a comparable basis, of accomplishing the same purpose which would preclude development if the plan were undertaken.

5. The cost for alternative plans of development were based on preliminary layouts, estimates of quantities and costs at January 1978 unit prices.

6. The benefits and costs are expressed to the fullest extent possible in comparable quantitative economic terms. Annual costs are based on a 50-year period of analysis and an interest rate of 6 7/8 percent. No interest during construction was included, since all of the project work could be completed within one construction year. The annual charges also include the estimated cost of maintenance.

ENVIRONMENTAL AND OTHER CRITERIA

7. The following were considered in formulating the optimum plan of improvement.

- Available sources of expertise to identify forms of marine life, which might be endangered, damaged, or destroyed by plan implementation, should be utilized.
- The use of natural resources to affect implementation of a plan should be minimized.

- Adverse social impacts (i.e. increased traffic congestion, noise should be minimized.
- Activities attracted to the project area after plan implementation should be commensurate with activities of the surrounding area, and be environmentally and socially acceptable.
- Incorporation of measures in the selected plan which protect, preserve, or enhance environmental quality in the project area.
- Coordination with interested federal and non-federal agencies, local groups, and individuals through cooperative efforts, conferences, meetings and other procedures.

POSSIBLE SOLUTIONS

8. To satisfy the need for improvement of Sesuit Harbor, two basic problems must be solved. One is the elimination of tidal delays and groundings by providing a deeper channel. The other is providing more berthing spaces to eliminate congestion as a result of channel improvement. There are two possible solutions available:

- Develop new facilities at some other site, or
- Modify existing conditions.

These alternatives are discussed in the following paragraphs.

9. The development of new facilities in the Sesuit Harbor area was considered as a possible solution to the problems of inaccessibility. This would require development of marina facilities or open anchorage as well as associated onshore development of access roads and parking area. Therefore, three separate areas of the coast were considered as possible alternative sites. See Plate D-1.

10. One site considered was a small cove 2 miles to the west called Nobscusset Harbor. This area is protected by a small stone jetty about 500 feet long extending south-eastward from Nobscusset Point. The cove is a small sandy half-tide area. There are no existing small boat facilities at this site. It is used entirely as a swimming beach by local residents. Littoral drift in this area is extensive, requiring sand arresting structures to keep any channels or berthing areas free

from sand deposition. Berthing areas would be too small without extensive excavation to accommodate the existing fleet using Sesuit Harbor, to say nothing about expansion for future use. Real estate for development of onshore facilities is not readily available and would require extensive land taking to develop a harbor similar to Sesuit Harbor.

11. East of Sesuit Harbor to the Brewster town line the coastline does not offer any sheltered area to develop a harbor without landfill to provide sufficient shore-based facilities. There is no protection from wind or wave action. Sand arresting structures would be necessary. Land transportation routes into the area are limited to unpaved access roads winding through extensively developed residential areas. A large salt marsh surrounding Quivett Creek abuts the area. Utilities are limited, providing service to a small number of summer residences. Land use of this area is now recreational in nature. The same problems would exist in developing a harbor along this reach as discussed in the previous paragraph.

12. The third area considered lies along the Nantucket Sound side of the town of Dennis, drained by Bass River. This area was studied for possible navigation improvements under separate study authority in 1972. A plan of improvement was found to be economically justified. The plan would have provided a dredged channel 6 feet deep and 100 feet wide from deep water in Nantucket Sound, 2 miles upstream to a point 1,000 feet beyond the Route 28 highway bridge, including 28 acres of anchorage just inside the river mouth. The estimated first cost of construction was \$480,000 equally shared by the federal government and local interests. The estimated benefit cost ratio was 2.2. However, by letter to the Division Engineer, the towns of Dennis and Yarmouth indicated that they could not meet the required local cost contribution at that time. Therefore, federal navigation improvement of Bass River could not be undertaken. Even if navigation improvement were made to Bass River it would not alleviate the need for improvement on the north shore of Dennis. Cape Cod Bay is geographically separated from Nantucket Sound by the easterly arm of Cape Cod. Because these offshore cruising areas are so widely separated they serve entirely different recreational fleets.

13. Modification of existing facilities at Sesuit Harbor was considered with a view towards providing access to the harbor which would be conducive to future expansion of boating facilities. The desired result would be to eliminate tidal delays, groundings and congestion within the harbor by more facility support for a larger portion of the fleet. Modification of existing piers, floats and berthing

areas are a responsibility of local interests and are beyond the scope of this study. However, availability of such modifications must be assured in order to justify federal participation in improving the existing entrance channel. Local interests are better able to finance upgrading of existing berthing facilities and expansion of these facilities than they are of building entirely new facilities outside of Sesuit Harbor.

14. Straightening and deepening the entrance channel into Sesuit Harbor, as requested by local interests, was considered for its impact on improving navigation. This alternative would be the least disruptive to the environment in view of the geographical conditions involved and most beneficial to utilization of the natural water resources offered by the area. Costs and benefits applied to this alternative are discussed later in this report.

15. To accept the alternative of "no improvement" at this time would prevent further development of the harbor and, in time, would reduce the effectiveness of the existing harbor as an asset to the region. This alternative is not consistent with the growing boating activities in the Cape Cod area nor would it meet the needs of local interests in terms of transportation costs, elimination of tidal delays and safe use of the harbor.

SUMMARY OF POSSIBLE SOLUTIONS

16. Sesuit Harbor is the only site between Cape Cod Canal and Wellfleet Harbor which is sufficiently developed for use by recreational boats to be worthy of further improvement without vast investment in new facilities. Movement of the fleet to new sites would be impractical, since a protected harbor is already available. Relocation would require extensive land-takings in seasonal residence areas and encroachment upon prime recreational lands. Further study of alternatives involving movement outside Sesuit Harbor has therefore been discontinued. Modification of existing facilities is, however, feasible. Channel improvements within the harbor will increase the efficiency of the harbor to meet future demands for expansion.

ALTERNATIVES CONSIDERED FURTHER

17. Discussion of alternatives, thus far, has been based on the premise that there is a need to relieve congestion and access to the harbor. Alternatives considering expansion into areas outside Sesuit Harbor have proven to be impractical. A "no improvement" alternative is contrary to local regional planning, as shown in previous paragraphs. Further consideration of possible alternatives will be limited to modifications to existing waterways as requested by local interests.

ENTRANCE CHANNEL IMPROVEMENTS

18. The proposed improvements to the entrance channel into Sesuit Harbor include straightening and deepening the channel. Channel depth is usually measured from low water datum and depends on many factors, including size and type of vessels, traveling speed, and wave magnitude. Traveling speeds govern the degree of squat which the vessel assumes while in motion. The channel depth is determined as the sum of draft, squat, wave height, and overdepth clearance. A minimum of 6 feet is considered for the total improved channel depth at this site. Consideration was also given to dredging the outer harbor channel to a depth of 8 feet. However, no more than 6 existing boats would need this depth of improvement in order to navigate at low tide. The cost of dredging this extra two feet of depth would far exceed the benefits derived from elimination of tidal delays.

19. The channel alignment should be as close to the natural channel alignment as possible. Any bends that are necessary should be gradual. The number, size of vessels, and distance to be travelled while navigating are factors which determine the width of the channel. The minimum width for small boat traffic should be about 5 times the beam of the widest boat expected to be berthed in the harbor. Sailboats using the harbor require extra width for tacking. Where boating activities are spread uniformly over several hours rather than concentrated in a few peak hours in the channel a narrower channel would be acceptable. In the case of Sesuit Harbor it was determined that a width of 100 feet would be optimum dimension based on foregoing criteria. The inner end of the channel at the basin entrance would have to be reduced to 80 feet to avoid expensive widening of the shoreline on both sides due to its topographical limitations.

20. The littoral drift i.e., sand movement along the shoreline, at the entrance to Sesuit Harbor appears to occur from both east and west but the net littoral transport is from the east. The wave and current forces which transport the sand change in strength and direction based on water depth changes. This causes sand to settle out as it passes by the entrance to the harbor. As the tide floods, the current picks up these particles and transports them into the harbor. As the tide ebbs, the current moves the sand seaward in the main stream while along the shoreline within tidal range the sand may continue to move landward due to reversal flow. The fresh water flow from Sesuit Creek combined with the ebb tide is not of sufficient velocity to flush out all of the sand brought in by the flood tides. As a result the entrance channel shoals. See Plate D-2.

21. To stabilize the location of the entrance channel, parallel jetties have been constructed seaward to the 6-foot depth contour. The primary function of a jetty is to protect the channel from waves and to intercept the littoral drift. At Sesuit Harbor the jetties have functioned as designed to intercept the littoral drift. Sand is now passing the ends of the jetties resulting in depths at the outer ends ranging from 4 to 6 feet depending upon the time of year that surveys are taken. Winter storms tend to deepen the entrance due to erosion from steep short period waves accompanying these storms. During the summer, long period gentle waves from offshore accrete sand across the entrance due to lesser wave energy.

22. To help reduce the need for maintenance dredging, in the event that channel improvement is implemented, consideration was given to extending both jetties to the 8-foot depth contour. This would provide added interception to the littoral drift. The future buildup of sand would be forced seaward into deep water where it could by-pass the proposed channel at a lower elevation. To accomplish this purpose the west jetty would have to be extended a distance of 350 feet and the east jetty for a distance of 450 feet. Cost estimates for the jetty extensions have been made based on the same dimensional construction criteria as the existing jetties. The top elevation would be 14 feet above mean low water with side slopes of 1 on 1.5. Top width would be 7 feet based on the required stone sizes needed to resist a design wave of 10 feet in magnitude. The total estimated construction cost for extending both jetties is \$829,000 at January 1978 prices. Total quantity of rock required to construct the extensions amounts to 32,800 tons. Annual charges including interest at 6 5/8 percent and amortization amounts to 54,400. Extension of the jetties would reduce the littoral drift entering the harbor to about 30 percent of the present total with the remainder attributed to sand entering the harbor system from wind action and erosion inside the harbor.

23. The Commonwealth of Massachusetts constructed 600 feet of revetment along the west bank of the harbor fronting the Dennis Yacht Club in 1958. The revetment was designed with a top elevation of +12.0, top width of 3 feet, and slope of 1 on 1.5 extending to -6.0 feet mean low water. Its purpose was to stabilize the sand slope and prevent further erosion into the navigation channel. About 8 feet behind this revetment and parallel to it is a timber bulkhead, in good condition, which fronts a grassed sand dune. The top elevation of this bulkhead is at +14.0. The revetment has settled over the years allowing overtopping conditions, during high spring tides. Sand to a depth of 2 feet or more has washed out drifting into the harbor. Consideration was given to excavating behind the revetment and placing a filter layer of gravel to act as a sand tight seal. However, to accomplish this would necessitate the removal and replacement of the timber bulkhead which protects the sand dune from tidal erosion. The estimated cost of this improvement is \$58,000. It would serve to prevent any further erosion behind the revetment. After further analysis of the problem it was decided that the narrow strip between the bulkhead and the top of the revetment is now in a stable condition and any further erosion from this area would be extremely small. It would be less expensive to periodically dredge material which might find its way into the channel from this source than to perform the sand tightening work.

24. The east bank has been stabilized by rock revetment in a like manner for a distance of 1,000 feet landward from the inner end of the east jetty. This revetment has deteriorated in certain locations over the years primarily from settlement and loss of individual stones. High tides overtop the structure causing minor erosion to the dunes behind the revetment. The material has washed into the harbor forming a small proportion of the present shoaling problem. Consideration has been given to raising the revetment to elevation of 14 feet above mean low water to eliminate overtopping by extreme high tides. This improvement would cut off a source of shoal material in the harbor and reduce the need for periodic dredging.

25. Probably the largest source of shoal material in the inner harbor has come from the beach and sand dunes located between the inner end of the west jetty and the Dennis Yacht Club wharf. This area is subjected to tidal action from flood tides flowing along the westerly side of the harbor. Sand from this area has been deposited in front of the west bank revetment giving the appearance that the sand has leached through the revetment. However, the sand deposit contains a far greater volume than would have been deposited if it came through the revetment. This is confirmed by the small difference in elevation between the top of the revetment and the sand remaining behind it. The foreshore in the west beach area has eroded down to a layer of peat between elevation +7 and mean low water with mud below low water. This area no longer contributes sand to the harbor channel except during storm periods

when tide and wave action can reach the dunes. The area is used by local residents for bathing at the upper tide stages. To cut off this area as a source of shoaling, rock revetment would be required covering the entire natural slope from about +5.0 feet to a top elevation of 14 feet mean low water. The cost of revetment to stabilize this shoreline would far exceed the annual maintenance dredging cost incurred from allowing the eroded material from this area to pass into the channel. Also, local residents would lose the bathing beach. Therefore, no work is contemplated for this area.

DISPOSAL ALTERNATIVES

26. The proposed improvements to the entrance channel at Sesuit Harbor involves material disposal methods which would be most economical and still cause the least disruption to the environment. Generally disposal of material at sea is more costly than disposal on land. Sea disposal involves the use of bucket dredges and bottom dump scows for hauling the material to offshore disposal sites. Bucket dredging methods cause more turbidity at both the dredging site and disposal site than hydraulic methods. Also, offshore disposal sites must be chosen where the least damage to marine organisms will occur. These disposal sites may be found to be too far away from the project site for economical hauling of material. Since all of the material to be dredged is fine to medium coarse sand as shown from previous dredging operations it would be less disruptive to dispose of the material on the beach west of the west jetty. Observations indicate that from a point approximately 500 feet west of the jetty, long shore currents would move the dredged sand westerly along the shore, away from the entrance channel. The beach in this area is partially owned by the town of Dennis. The remainder of the disposal area is privately-owned. Placement of the sand on the beach would conform to past disposal methods for dredging of Sesuit Harbor as the Commonwealth of Massachusetts has used the beach east of the harbor during maintenance dredging operations with no adverse effects on the environment. See Plate D-1.

27. Disposal on land at other locations would require substantial diking of the disposal areas by local interests prior to dredging operations. It would also require an area of at least 6 acres where the dredged material would be placed to maximum depth of 4 feet. This is the smallest disposal area which could be utilized using hydraulic dredging methods. Maximum horizontal pumping distance without a booster pump would be limited to approximately 5,000 feet from the dredging site. A booster pump would nearly double the cost of dredging

disposal. Land use around Sesuit Harbor precludes the possibility of obtaining a disposal site of this magnitude without serious disruption of the social and environmental aspects of the area. There are some low lying marshy areas within an economical pumping distance which could be utilized but the adverse environmental effects of disposal would exceed any detrimental effects of disposal on the beach.

CONCLUSIONS

28. On the basis of technological, economical and environmental criteria, the improvement of the entrance channel by deepening and widening to provide adequate access to the harbor was found to be the most favorable alternative to alleviate the problems of tidal delays. This alternative will provide access to all the berthing facilities. An alternative that would provide a harbor at any other site was found to be unwarranted. Selection of disposal of dredged material on the beach west of the harbor would best fulfill the economic and environmental criteria for disposal.

29. Extension of the jetties seaward to the 8-foot depth contour combined with sand tightening of the riprap revetment on the west bank and raising the east bank revetment would reduce the sources of shoaling in the entrance channel. However, it would be more costly to amortize the construction of these features than to provide frequent maintenance dredging of the channel during the life of the project.

SELECTING A PLAN

30. Navigation improvements at Sesuit Harbor have been considered to determine an alternative which would combine an economically efficient waterway system with the least environmental disruption possible. Underlying this study is the goal of eliminating tidal delays and groundings by providing adequate access to the harbor. To this end, selection was made of a plan to deepen the entrance channel to a depth of 6 feet below mean low water and widen the channel to 100 feet narrowing to 80 feet at the entrance to the inner basin. The dredged material would be placed on the beach west of the harbor. These improvements are consonant with the desires of local interests and in the interests of economics and the environment.

NATIONAL ECONOMIC DEVELOPMENT PLAN

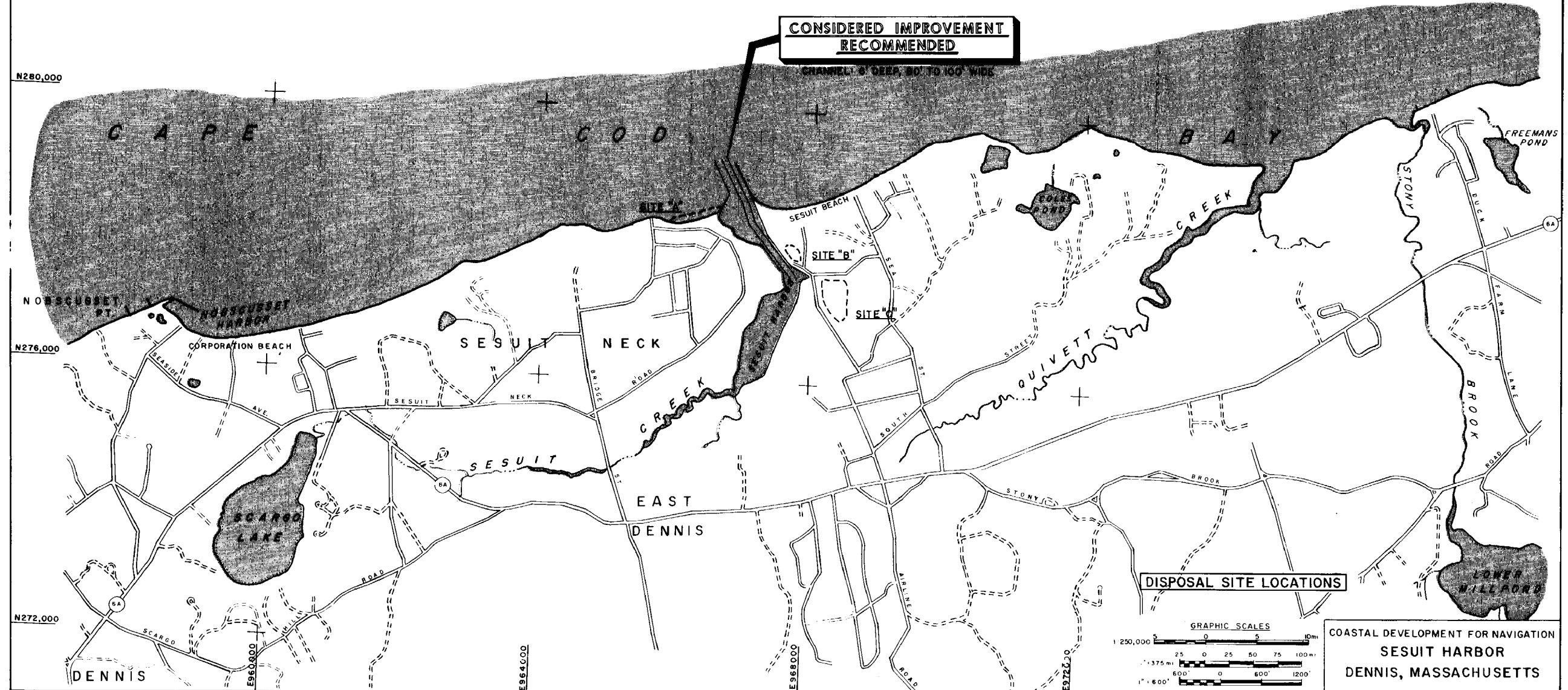
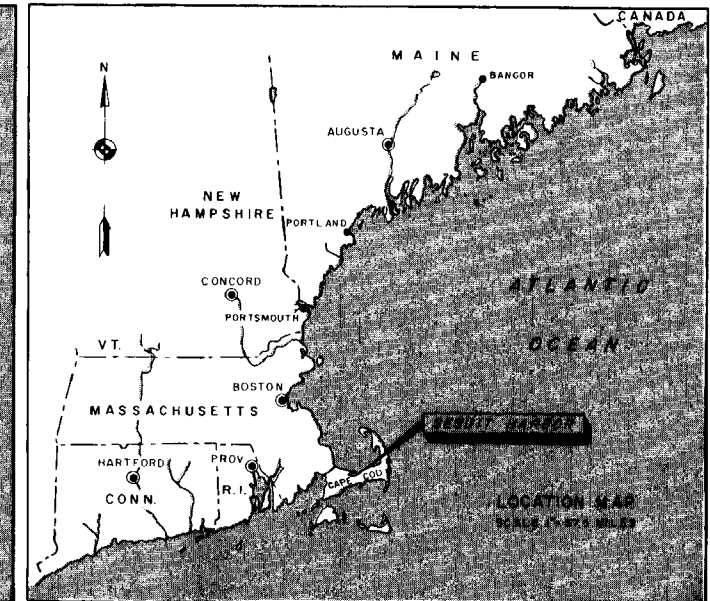
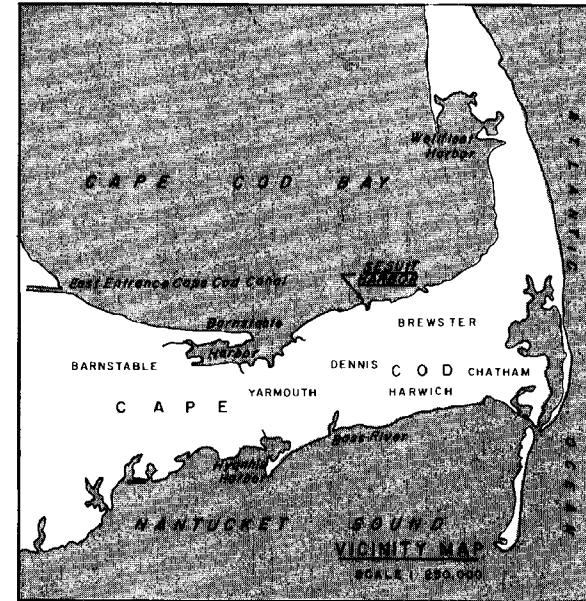
31. Of the alternatives considered during the study, the greatest net benefit would result if the channel was improved from the entrance to the harbor into the inner boat basin without extension of the jetties at the entrance. The analysis indicated that although the jetty extension would reduce the volume of material which would enter the harbor causing shoaling of the improved channel, it would be less costly to perform frequent maintenance dredging than to amortize the cost of the jetty extensions over the project life. A detailed benefit to cost analysis for selection of the plan indicates that the net benefits would be maximized without the jetty extension and sand tightening work. On this basis the National Economic Development Plan is the same as the selected plan.

ENVIRONMENTAL QUALITY PLAN

32. The Environmental Quality Plan is an alternative which makes the most significant contribution to the management, conservation, preservation, creation, restoration, or improvement of the quality of certain natural and cultural resources and ecological systems. In terms of navigation in the Sesuit Harbor area, environmental quality would be enhanced by either reversing the trend of boating activity and restoring the area to the way it was before development took place, or by preserving other areas in the vicinity and developing the potential use of the harbor. The coastal management programs of local governmental agencies are committed to full development of resources and facilities where they exist, thus preserving other areas for recreational and wildlife preserves. Accordingly, the Environmental Quality Plan would be to fully develop existing facilities with minimum adverse environmental impacts. The Environmental Quality Plan is the same as the selected plan, which provides the minimum safe channel configuration necessary, while disposing of the dredged material at a site which would least affect the environment. Use of the beach for disposal would allow preservation of the shoreline in this area from further erosion and provide a natural resource for recreational purposes.

SUMMARY

33. The analysis of annual costs and benefits for the selected plan are contained in Section F of this Appendix. The National Economic Development Plan and the Environmental Quality Plan are the same as the selected plan. Based on study findings, the remaining sections of this report will deal with costs, benefits, and effects of the selected plan. A System of Accounts, as required in Principles and Standards is shown on Plate D-3 and includes summary comparisons of all alternatives plans considered.



COASTAL DEVELOPMENT FOR NAVIGATION
SESUIT HARBOR
DENNIS, MASSACHUSETTS

BORING NOTES

Normal length of continuous drive of sample spoon is 5.0 feet. Penetration resistance of sampling spoon increases with length of drive, and blow counts, therefore, generally increase correspondingly except where distinct changes in material occur within the length of drive. In gravels, sands and gravels, and some glacial till, the presence of coarse gravel, cobble or boulder sizes causes the blow count to become erratic, and therefore may not be indicative of the degree of compaction.

While the explorations are representative of subsurface conditions of their respective locations and for their respective vertical reaches, local variations characteristic of the overburden and rocks of this region are anticipated and if encountered, such variations will not be considered as differing materially from represented conditions.

Location of borings shown thus ● FD-2

RECOMMENDED IMPROVEMENT CHANNEL-6 FEET DEEP, 80 TO 100 FEET WIDE

LEGEND FOR GRAPHIC LOGS

FD Foundation test boring
Date exploration completed.
Elevation of ground surface during time of exploration.

SM Group letter symbol according to United Soils Classification.

Blows per foot of penetration for each sample drive using a 140 lb. hammer with free fall of 30 inches on a standard 5.0 foot solid sample spoon with a beveled sharpened shoe.

FD-1
30 Oct. 1974
El. 5.3' M.L.W.

0.2'	SP	Silty, fine SAND
2.3'	SM	
2.1'	SP	Medium to fine SAND with traces of silt
5.0'	SP	
2.9'	SP	
8.0'	SM	
10.0'	SM	

FD-2
31 Oct. 1974
El. 4.8' M.L.W.

0.0'	SP	Silty, fine SAND
5.0'	SM	
7.0'	SP	Silty, fine SAND
8.8'	SM	
10.0'	SM	
13.0'	SM	

FD-3
31 Oct. 1974
El. 7.8' M.L.W.

0.0'	SP	Silty, fine SAND with fibers
5.0'	SM	
8.3'	SP	Medium to fine SAND with traces of silt
10.0'	ML	SILT with traces of gravel
13.0'	SM	fine, sandy SILT with gravel

GRAPHIC LOGS SCALE: 1"=5'

ENVIRONMENTAL SAMPLES

NO.	MATERIAL
PE-1	MUD
PE-2	MUD
PE-3	GRASS, MUD, SAND
PE-4	MUD
PE-5	MUD
PE-6	SAND
PE-7	SAND

SAMPLING ACCOMPLISHED DEC. 1975

GE-1	SAND
GE-2	SANDY GRAVEL
GE-3	SAND
GE-4	SAND

GEN. NOTES:

Soundings are in feet and tenths and are referred to the plane of Mean Low Water.

Hydrography from survey of Dec. 16, 17, 18, 1974 & Jan. 8, 10, 1975.

Topography from previous survey B.M. Marina (New Corps of Engineers disc) was established because of concrete being raised 6" above old concrete. Elev. above M.L.W. is 16.93.

Coordinates are on the Lambert System for the Comm. of Mass.

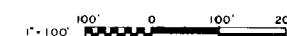
Field books: RBH 3503, 3548, 3549.

The information depicted on this map represents the results of surveys made on the dates indicated and can only be considered as indicating the general conditions existing at that time.

Environmental samples shown thus: ● PE-2

Mean High Water shown thus: ———

Recommended project shown thus: ———

GRAPHIC SCALES

SESUIT HARBOR

DENNIS, MASS.

REPORT SURVEY

NEW ENGLAND DIVISION-CORPS OF ENGINEERS

PLATE D-3
SYSTEM OF ACCOUNTS

	1 NEW DEVELOPMENT AT NOBSCUSSET HARBOR WITH DISPOSAL AT SEA	2 NEW DEVELOPMENT AT QUIVETT CREEK WITH DISPOSAL AT SEA	3 IMPROVEMENT AT SESUIT HARBOR BY DEEPENING EXISTING CHANNEL, EXTENSION OF EXISTING JETTIES RAISING REVETMENT DREDGING DISPOSAL AT SEA	4 IMPROVEMENT AT SESUIT HARBOR BY DEEPENING EXISTING CHANNEL, EXTENSION OF EAST JETTY DISPOSAL ON BEACH	5 IMPROVEMENT AT SESUIT HARBOR BY DEEPENING EXISTING CHANNEL WITH DISPOSAL AT SEA	6 IMPROVEMENT AT SESUIT HARBOR BY DEEPENING EXISTING CHANNEL WITH DISPOSAL ON BEACH SELECTED PLAN IS NED AND EQ PLAN
<u>PLAN DATA</u>						
Structures - Federal	Dredge Access Channels, Erect Breakwater and Sand Arresting Structures	Same as 1	Dredging Existing Channel, Extension of Jetties and Raising Revetment on East Bank	Dredging Existing Channel, Extension East Jetty	Dredging Existing Channel	Same as 5
Structures - Local	Locals to Construct New Marina, and Onshore Facilities	Same as 1	None	Locals to Provide Temporary Diking or Pay Equivalent, Costs	Maintain Existing Jetties	Same as 5
Land Requirement - Federal Project	None	None	None	6 Acres for Material Disposal	None	Same as 4
Land Requirement - Local Supporting Projects	Approximately 20 Acres	Same as 1	None	None	None	None
<u>NATIONAL ECONOMIC DEVELOPMENT</u>						
Implementation Cost	NQ	NQ	\$1,318,000	\$703,000	\$286,400	\$228,000
Federal			659,000	351,500	143,200	114,000
Non-Federal			659,000	351,500	143,200	114,000
Private			0	0	0	0
Total			1,318,000	\$703,000	\$286,400	\$228,000

REVISED JANUARY 1980

PLANNING DIVISION
COASTAL DEVELOPMENT
FOR NAVIGATION

PLATE D-3
SYSTEM OF ACCOUNTS (CONT.)

	1	2	3	4	5	6
Average Annual Benefits						
Existing Fleet			69,000	51,100	33,500	
Boats Added Immediately	NQ	NQ	90,700	86,000	81,200	
Future Growth			83,200	75,700	68,400	Same as 5
Existing Transients			6,400	4,300	2,300	
Future Transients			14,300	13,100	11,900	
Total	NQ	NQ	\$263,600	230,200	197,300	
Average Annual Costs						
Construction			91,000	48,495	19,757	15,800
Maintenance	NQ	NQ	20,500	21,600	32,300	29,800
Total			111,500	70,095	52,057	44,600
Benefit - Cost Ratio	NQ	NQ	2.4	3.3	3.8	4.4
ENVIRONMENTAL QUALITY						
Water Quality						
Turbidity at Dredge Site	Yes	Yes	Yes	Yes	Yes	Yes
Effluent Discharge at Dredge Site	No	No	No	No	No	No
Land Disposal Promotes Leaching of Effluent into Tidal Lands	No	No	No	Yes	No	Yes
Air Quality						
Increased Fuel Emmissions from Vessels and Vehicles	Yes	Yes	Yes	Yes	Yes	Yes
Short Term Dust Conditions at Disposal Site	No	No	No	Yes	No	Yes
Dust and Noise at Dredging Area	Yes	Yes	Dust No Noise Yes	Yes	Same as 3	Same as 3
Dust and Noise Onshore Construction Sites	Yes	Yes	Yes	Yes	No	Yes
Short Term Marine Odor During Dredging Operations	No	No	No	Yes	No	Yes

Note: NQ = Not Qualified

PLANNING DIVISION
COASTAL DEVELOPMENT
FOR NAVIGATION

PLATE D-3
SYSTEM OF ACCOUNTS (CONT.)

	1	2	3			
Land Use						
Wetlands, Lost	No	Yes	No	No	No	No
Commercial Land Use	No	No	No	No	No	No
Disrupted	Yes by Onshore	Same as 1	No	No	No	No
Residential Land Lost	Construction					
Sufficient Land for Land	N/A	N/A	N/A	Yes	N/A	Yes
Disposal	Yes	No	No	No	No	No
Recreational Land Lost	No	Yes	No	No	No	No
Wildlife Area Lost						
Plants						
Vegetation Destroyed	None Except at	Yes	No	No	No	No
Tidal Vegetation Destroyed	Land Construction Sites	Yes	No	No	No	No
Animals						
Wildlife Displaced	No	Yes	No	No	No	No
Wildlife Destroyed	No	Yes	No	No	No	No
Bethnic Fauna Destroyed	Yes - at Sea	Yes - at Sea	Yes - at Sea	No	Yes - at Sea	No
	Disposal Site	Disposal Site	Disposal Site		Disposal Site	
Temporary Disruption	Yes	Yes	Yes	No	Yes	No
of Fish Habitat	Yes - at Sea	Yes - at Sea	Yes - at Sea	No	Yes - at Sea	No
Permanent Disruption	Disposal Site	Disposal Site	Disposal Site		Disposal Site	
of Fish Habitat						

PLANNING DIVISION
COASTAL DEVELOPMENT
FOR NAVIGATION

PLATE D-3
SYSTEM OF ACCOUNTS (CONT.)

	1	2	3	4	5	6
Visual Appearance						
Temporary Loss of Aesthetics	Yes - Shoreline Changes	Yes - Shoreline Changes	Yes - Jetty Extensions	Yes - Jetty Extensions	No	Yes - at Disposal Site
Support Construction Required	Yes - Extensive Shore Facilities	Yes - Extensive Shore Facilities	Yes - Expansion of Marina	Same as 3	Same as 3	Same as 3
Industrial/ Commercial Development Encouraged	Yes	Yes	Yes	Yes	Yes	Yes
Land Filling Necessary	No	Yes - To Support Construction of New Project	No	No	No	No
Increase Vehicle Activity in Existing Port Area	No	No	Yes	Yes	Yes	Yes
Increase Vehicle Activity in Other Areas	Yes	Yes	No	No	No	No
Archeological and Historical Value Lost	Yes - Old Residences	No	Yes - Original Jetty Structures	Yes - Original Jetty Structure	No	No
<u>SOCIAL WELL-BEING</u>						
Encourages a Diversified Base Through New Industrial Development	Yes	Yes	No	No	No	No
Decreases Risk of Vessel Collisions	Yes	Yes	Yes	Yes	Yes	Yes
Short Term Disruption of Vehicular Traffic	During Construction	During Construction	During Construction	During Construction	No	No
Concentration of Heavy Equipment on Land Increases Potential Hazard to Health and Safety During Construction	Yes	Yes	Yes	Yes	No	No

PLANNING DIVISION
COASTAL DEVELOPMENT
FOR NAVIGATION

SHEET 4 OF 7

PLATE D-3
SYSTEM OF ACCOUNTS (CONT.)

	1	2	3	4	5	6
Overall Navigation Project Will Require Local Labor	No	No	No	No	No	No
Related Development of Facilities Will Require Local Labor	Yes	Yes	Yes	Yes	Yes	Yes
Industrial, Commercial, and Residential Relocation Necessary	Yes	Yes	No	No	No	No
Disrupts Commercial Business Activities	Yes - Move From Existing Harbor	Yes - Move From Existing Harbor	No	No	No	No
Disrupts Recreational Activities	Loss of Beach	No	Yes - Beach Area	Yes - Beach Area	No	Yes - Beach Area
Related Commercial Development Will Increase Tax Revenues	No	Yes	Yes	Yes	Yes	Yes
Large Local Investment Required To Develop Related Commercial Facilities	Yes	Yes	No	No	No	No
Decreasing Transportation Costs Passed on to Consumer	N/A	N/A	N/A	N/A	N/A	N/A
Disrupts or Over Extends Police and Fire Protection	Yes	Yes	No	No	No	No
Loss of Estuarine Habitat Used for Educational Purposes	No	Yes	No	No	No	No
Project Makes Maximum Use of Existing Commercial Facilities	No	No	Yes	Yes	Yes	Yes
<u>REGIONAL DEVELOPMENT</u>						
Supports Industrial and Commercial Growth	Yes	Yes	Yes	Yes	Yes	Yes
Provides Service and Maintenance Facilities	Yes	Yes	Yes	Yes	Yes	Yes

PLANNING DIVISION
COASTAL DEVELOPMENT
FOR NAVIGATION

PLATE D-3
SYSTEM OF ACCOUNTS (CONT.)

	1	2	3	4	5	6
Majority of Construction Labor for Basic Project Hired Locally	Yes - for Support Facilities	Yes - for Support Facilities	No	No	No	No
Construction Expenses would Increase Local Income Through Secondary and Induced Economic Activity	Yes	Yes	Yes	Yes	Yes	Yes
Non-Federal Government Funds Required for Implementation of Portion of Project	Yes - Large Investment for Support Facilities	Yes - Large Investment for Support Facilities	50 Percent of Project	Same as 3 Inc. Disposal Dikes	Same as 3	Same as 3 Including Disposal Dikes
Disrupts Commercial Production During Implementation	No	No	Yes - Boats Delayed During Dredging	Same as 3	Same as 3	Same as 3
Increases Capacity of Port To Handle Fishing Catch	Yes	Yes	Local Interests Could Provide Facilities	Same as 3	Same as 3	Same as 3
<u>OTHER EVALUATED CRITERIA</u>						
Achieves Transportation and Operating Savings to Recreation Boats	Yes	Yes	Yes	Yes	Yes	Yes
Minimizes Adverse Social Impacts	No - Recreational and Residential Areas Relocated	No - Destroys Conservation Area of Marsh	Yes	Yes	Yes	Yes
Navigation Benefits Exceed Cost	NQ	NQ	Yes	Yes	Yes	Yes
Efficient Method for Meeting Needs of Sesuit Harbor Recreational Boating	No - Too Much Local Investment Required for Benefits Received	No - Too Much Local Opposition Due to Wetlands	Yes	Yes	Yes	Yes

Note: NQ = Not Qualified

PLANNING DIVISION
COASTAL DEVELOPMENT
FOR NAVIGATION

SHEET 6 OF 7

PLATE D-3
SYSTEM OF ACCOUNTS (CONT.)

	1	2	3	4	5	6
Area Could Easily be Relocated To Former Condition After Plan is Implemented	No	No	No - Due to Jetty Extensions	No - Due to Jetty Extensions	Yes	Yes
Plan is Acceptable to Local Government Agencies	No	No	No	No	No	Yes
Congestion in Recreational Boat Mooring Area is Reduced	Yes	Yes	No - Plan does Not Affect Berthing Area	No	No	No
State and Local Port Development Plans are Complimented by Plan	No	No	Yes	Yes	Yes	Yes
Local Interests Receive Non-Related Benefits as a Result of Plan Implementation	None Known	None Known	None Known	Yes - Fill Available For Beach Erosion	None Known	Yes - Fill Available For Beach Erosion

PLANNING DIVISION
COASTAL DEVELOPMENT
FOR NAVIGATION

SECTION E

THE SELECTED PLAN

1. This section describes the plan of improvement selected in the previous section on formulating a plan. The description discusses the plan elements and its meaningful effects, both favorable and unfavorable. Information is presented on design, construction, and maintenance as required for a reasonable understanding of the technical aspects of the plan. Economic information is presented in a subsequent section.

PLAN DISCRIPTION

2. The selected plan of channel improvements for Sesuit Harbor was determined to be the most responsive and feasible means of providing transportation savings and reduction of tidal delays and damages to the recreational boating industry, while causing the least environmental detriment to the waters of the harbor and surrounding lands. The National Economic Development Plan and the Environmental Quality Plan are the same as the selected plan. The plan provides for a 6-foot deep channel, 100 feet wide from deep water in Cape Cod Bay leading into Sesuit Harbor to a point opposite the inner end of the east jetty; thence reducing to 80 feet in width at the entrance to the inner basin for a total distance of 2,400 feet. This improvement plan provides access to the berthing and mooring areas within the inner harbor.

DISPOSAL AREAS

3. Disposal of approximately 40,000 cubic yards of bottom materials will be necessary. Land disposal is the most feasible alternative, since deep water disposal sites are not available within a short haul distance from the harbor. Also, a valuable resource would be lost if the material was disposal at sea. Approximately 40,000 cubic yards of fine to medium sand will be deposited on the beach west of the harbor entrance between 500 and 1500 feet west of the west jetty. Placement of sand closer to the jetty would defeat the purpose of the jetty to catch any sand drifting along the shore in the tidal range toward the harbor entrance. The disposal of the sand will be controlled by construction of temporary retention dikes made from existing beach

materials. Following disposal, the beach will be graded to a natural slope of 1 on 15 above half tide level. The remaining sand deposited below this elevation will be allowed to assume a natural slope from tide and wave action.

4. There would be no interference with vehicular traffic in the vicinity of the disposal site as pipelines would not cross existing roadways. Vessel traffic through the entrance channel will be disrupted to a minor extent during dredging operations. All transportation disruptions will have a minimal effect if construction is accomplished during the off-season, avoiding the congestion resulting from heavy tourist and recreational use of the highways.

UTILITIES

5. No known utilities cross overhead or beneath the entrance channel to Sesuit Harbor.

PERTINENT DATA OF PLAN

6. A summary of information relating to the plan of improvement is presented in the following table:

TABLE E-1

PERTINENT DATA OF PLAN

Item	Data
<u>Entrance Channel:</u>	
Length, widened section, feet	2,400
Bottom width, feet	80-100
Side Slopes	1 on 3
Dredging Quantities, cubic yards	39,000
Maintenance, average annual	10,000
<u>Disposal Areas:</u>	
Beach length in feet	1,000
Top of berm elevation mltw	+12.0
Width of berm, feet	varies
Foreshore slope to elevation +6.0	1 on 15
Below 6.0 natural	1 on 30
Volume in cubic yards	40,000

EVALUATED ACCOMPLISHMENTS

7. The evaluated accomplishments that would result from the proposed plan of improvement are direct savings to existing and future users of the harbor through elimination of tidal delays, groundings and collisions. Tidal delays to a few larger vessels are still probable; however, these could be minimized by scheduling arrival or departure to take advantage of favorable tides. A non-evaluated accomplishment resulting from the proposed plan is the possible use of the harbor by fishing vessels, provided onshore facilities for landing catches and storage of equipment are made by local interests. Also, the improved harbor access would provide a harbor of refuge for vessels caught offshore by adverse weather conditions.

8. Evaluated benefits accruing to the recreational boating interests are developed and explained in detail on Section F.

9. Other benefits accrue to local interests due to the project features, although they are not applied to the project study. The sand placed on the beach would serve to protect the backshore sand dunes from erosion and provide additional recreational beach area.

EFFECTS ON THE ENVIRONMENT

DREDGING AND DISPOSAL

10. The dredging of the channel and the disposal of the dredged material on land will affect both marine and terrestrial organisms. Removal of the bottom materials in the channel will temporarily reduce the number of bottom dwelling organisms which cannot evacuate the dredging site. Macrobenthic organisms identified in the harbor include hard and soft shell clams, scallops and mussels. Based on similar dredging project studies, it appears that dredging operations will physically destroy biological communities in the path of the dredge. As the habitat is destroyed, these organisms will be removed and redistributed or destroyed. Destruction will be maximal in the channel, while some slight effects can be expected in adjacent areas. Localized effects on finfish are expected. Adult finfish should easily avoid the dredge-

ing area. Disposal of material on the beach will destroy little flora or fauna. Any fauna losing its habitat will be destroyed or relocated. Impacts on the water column and benthic community will be short term effects. The animal life in Sesuit Harbor has easily adapted and restored itself after dredging operations as evident from past dredging experience in this area. Since the project is consolidated within a small area, adverse impacts on ecological systems will have no lasting long term effects.

WATER QUALITY

11. Levels of dissolved oxygen and turbidity in the waters of Sesuit Harbor will be affected by the dredging and disposal operations. Short term increases in turbidity around the cutter head of the dredge will result from suspended sediments stirred up by the operation. Dissolved oxygen levels will be temporarily suppressed since small amounts of resuspended organic sediments will require oxygen for bacterial decomposition. This suppression will have little impact on overall water quality. The minor concentrations of toxic heavy metals and other chemicals should have no great effect on resident or migratory biota. Population of organisms within the harbor environment would be at its lowest activity during the colder months when dredging would be performed. There are no usable groundwater resources in the disposal areas which could be affected.

AIR QUALITY

12. As a result of the improvement, vessel and vehicle traffic is expected to increase causing an increase in air pollution levels. Dusty conditions could result from wind erosion in the disposal area. Marine odors will be evident during disposal of the dredged materials and for a short time during the drying period. However, it is anticipated that these odors will be no worse than those experienced during low tide periods under existing conditions.

OTHER EFFECTS

13. The proposed channel improvement would produce social and economic benefits in the area. The project would not guarantee economic growth but would support such growth since there are many other factors affecting the area's growth potential. The lack of an improved channel would require development of future facilities at other locations causing a far greater investment by local and state interests. There are associated indirect benefits from the improvement such as increased commercial trading activities in the area. Boating enthusiasts from other ports cruising offshore would feel more confident knowing that there is a harbor of refuge within reach in case of sudden summer storms.

DESIGN

14. The major design considerations in channel improvements are those relating to dimensions (width and depth). The depth of water under the keel of a boat should be sufficient for safe and efficient operation. To obtain the proper depth requirements, consideration is given to the loaded draft of a vessel, squat, trim, maneuverability, salinities, and wave action. Factors considered in determining channel width are various passing situations, vessel control, speed, current, wind velocities and direction, magnitude and direction of wave action and the characteristics of the soil forming the channel banks.

15. The entrance channel to Sesuit Harbor is a relatively protected waterway with current velocities reaching no more than 0.8 knot on the ebb tide. There is no freshwater inflow of significance. Depth allowance for wave action and freshwater are not critical. Speed of boats using the harbor is limited to 6 miles per hour. Fine sandy material is found throughout the channel area. Based on the above factors, a minimum channel depth of 6 feet would accommodate all but a few of the larger vessels. A channel width of 100 feet was selected to provide adequate passing clearances through the entrance. At the inner end the channel width had to be reduced to 80 feet due to the close proximity of the shoreline. This width is adequate for a short distance as the boats would be travelling slowly at the mooring basin and berths.

16. The channel would be dredged with a one-foot allowable overdepth to provide a clear depth of 6 feet at mean low water. Side slopes would be "box" cut, allowing the side slopes to stabilize at approximately a slope of 1 on 3.

CONSTRUCTION

17. Assuming federal authorization and appropriation in conjunction with local cooperation, final contract plans for dredging could be completed within one year. The disposal dikes with spillway control structures would be provided by local interests. As an option to facilitate construction of the project, the equivalent funds could be provided by local interests and the required diking could be accomplished by the federal dredging contractor. Fill for retention dike construction is available on site.

18. A 12-inch hydraulic dredge will be used to accomplish channel improvements following construction of the retention dikes. Dredged material will be deposited in the disposal site directly by pipeline. No booster pump would be necessary to reach the disposal site. Effluent at the beach site will be onto the foreshore of the beach.

Dredging of 40,000 cubic yards of fine sand will cost \$164,000 (\$4.10/c.y.) at January 1978 prices. Contingencies (\$25,000), Engineering and Design (\$17,000), and Supervision and Administration (\$22,000) lead to a total dredging cost of \$228,000.

OPERATION AND MAINTENANCE

19. The bulk of the material causing shoaling of the existing dredged channel in Sesuit Harbor comes from littoral drift along shore outside the harbor. Tidal action accompanied by waves draws this sand into the entrance channel where it is trapped by the jetties. Sand along the foreshore and dunes at the inner end of the west jetty is eroded by flood tidal currents and transported into the channel opposite the Dennis Yacht Club and Sesuit Marina. Overtopping of the revetment by high tidal surges erodes the sand dunes along the east side of the harbor. Ebb tide currents transport the eroded material into the channel depositing it at the toe of the revetment and east jetty.

All of these sources contribute to excessive shoaling conditions. Extension of the jetties seaward to the 8-foot depth contour would reduce the passage of sand into the entrance for awhile, but it is possible that an offshore bar would eventually form seaward of the jetty extensions causing additional dredging needs. Material eroded from the areas inside the west jetty does not appear to be a major source of shoaling any more as peat and hardpan are now exposed in the tidal range below mean high water. Shoaling sources from within the harbor have diminished to the extent that they are no longer contributing any significant amount to the present shoaling problem.

20. If both jetties were extended to the 8-foot contour, the annual shoaling rate could be reduced to approximately 2,000 cubic yards. However, the interest and amortization of the jetties would amount to \$80,200 annually over the life of the project. Annual maintenance dredging costs would be \$6,000 for a total of \$86,200. Without jetty extension it is considered that 6,000 c.y. would be the annual shoaling rate from littoral drift entering the harbor. Maintenance dredging would under the selected plan be required approximately every four years at an annual cost of \$26,000 compared to an annual cost of \$86,200 if the alternative of extending both jetties was performed. Thus, extension of both jetties would not be economical to reduce maintenance dredging.

21. Investigations and field observations indicate that the net littoral drift outside the harbor entrance is predominantly from the east toward the west. Extension of the east jetty to the 8-foot depth contour for a distance of 450 feet would cost \$341,000 for initial construction. Sand entering the harbor could be reduced to an annual maintenance amount of 3,000 c.y. by this extension compared to an estimated 6,000 c.y. without extension of the jetty. Annual dredging maintenance costs would be reduced from \$26,000 to \$16,000 for a net savings of \$10,000. However, annual charges for interest, amortization and maintenance of the jetty extension are estimated to be \$36,000; thus, the cost of extension would exceed the savings in annual dredging cost under the selected plan.

22. Consideration was given to raising the existing revetment along the east bank of the harbor to a top elevation of 14 feet above mean low water for a distance of 1,000 feet. Raising the revetment would prevent overtopping of the existing structure under adverse storm conditions which occur on an average of once every two years. This overtopping has caused small quantities of sand to pass into the harbor from a narrow strip of land behind the revetment causing minor shoaling in

the existing channel. The estimated cost of raising the revetment amounts to \$117,300 at current prices. Annual charges including interest, amortization and maintenance of the work amount to an estimated \$12,904. Future sources of shoaling from this area are estimated to be less than 1,000 cubic yards per year. Thus, raising of the revetment is not economically justified.

23. Although the present condition of the jetties at Sesuit Harbor is good except for some displaced stones at the tip of the east jetty, it is clear that in order to maintain the proposed improved channel, it will be necessary to maintain the existing jetties. To allow the existing jetties to deteriorate will certainly contribute to an increase in the estimated shoaling rate in the proposed channel and ultimately threaten the ability of the Federal Government to maintain any stabilized channel.

SECTION F

ECONOMICS OF THE SELECTED PLAN

1. Section F comprises the cost and benefits of the selected plan. Other feasible alternative plans studied in Section D are also discussed in economic terms in this section. The following material presents the effects of the proposed improvements which can be evaluated in dollar terms. Other effects have been discussed in Section E.

METHODOLOGY

2. The economic justification of the proposed improvement was determined by comparing the equivalent average annual costs with evaluated average annual benefits accruing to the project over its economic life span. The average annual benefits should equal or exceed the annual costs for the Federal Government to participate in construction and maintenance of the project.

3. Benefits and costs are compared by putting them on an average annual basis using an interest and amortization rate of 6-7/8 percent currently applicable to federal projects.

4. A number of economic and physical factors limit the so-called economic life of a project; such as, the predicted rate of shoaling, changes in types and size of boats comprising the benefited fleet and inaccuracies in projecting long term values. Based on these factors, an economic life of 50 years has been selected for project analysis.

5. Development of costs and benefits follows standard Corps of Engineers practices. All goods and services required in development of the project are estimated in monetary terms. Benefits would result from safe and ready access to the harbor and its present and proposed facilities, elimination or reduction of tidal delays and increased efficiency of operation.

FIRST COST

6. Total first cost of construction was estimated for a 6-foot deep channel below mean low water in Sesuit Harbor.

TABLE F-1

Summary of Estimated First Costs (1) and (2)
Entrance Channel - 6-Foot Depth

Hydraulic Dredging of 40,000 c.y. (including 1-foot overdepth @ \$4.10)	\$164,000
Contingencies @ 15 percent	25,000
Supervision, Administration, Engineering and Design	<u>39,000</u>
TOTAL ESTIMATED FIRST COST	\$228,000

- (1) Excludes pre-authorization study cost of \$59,000
(2) Based on January 1978 prices

ANNUAL COST

7. Estimated annual costs are based on a 50-year economic life. The investment cost equals the first cost because of the short time frame required to accomplish construction. Interests and amortization charges are based on an interest rate of 6-7/8 percent. The estimated maintenance cost reflects previous experience with dredging other projects with similar conditions. Table F-2 summarizes the annual costs.

TABLE F-2

Summary of Estimated Annual Costs
Entrance Channel - 6-Foot Depth

Annual Charges

Interest & Amortization @ 6 7/8 percent	\$16,300
Maintenance Dredging of 6,000 c.y.	25,800
Jetty Maintenance	<u>3,000</u>
TOTAL ANNUAL COSTS	45,100

BENEFITS-SELECTED PLAN

8. This section of the report presents the benefit analysis to determine the economic feasibility of the proposed channel improvement for Sesuit Harbor.

9. Benefits derived from the planned improvement consist primarily of transportation savings. In addition to these primary benefits, secondary regional beneficial effects will be realized.

METHOD OF ANALYSIS

10. Most of the estimated benefits would accrue to recreational boating. These benefits have been computed on the basis of annual net return to the owners if the boats were "for hire." The ideal percentage of return is considered the maximum return that could be expected with full unrestricted use of the harbor. Generally, the net return varies with the type and size of the boat.

11. Tangible benefits would accrue to the existing pleasure boats, additional new boats purchased immediately upon completion of the improvement, gradual growth over the life of the project, existing transient fleet and expected increase in the transient fleet due to the improvement.

12. The existing locally based fleet in Sesuit Harbor is composed of 365 boats based on July 1975 statistics provided by local interests. The boats are on moorings and at marina berths. The town of Dennis can currently accommodate 233 boats at marina berths. Sesuit Marine Service can accommodate 56 boats in slips. The 76 remaining boats are moored in two areas, in deep water adjacent to the town marina and in the outer harbor at the Dennis Yacht Club. Approximately 28 percent of the boats are of the smaller outboard or inboard class that would be launched and hauled each day. However, a net gain in percent return would be realized by these shallow draft boats as well as the larger cruisers because of the shoal controlling depth in the entrance channel. Benefits to the locally based fleet have been estimated to amount to \$33,500 after allowance for a proper reduction in time while these boats are on cruise. (See Table F-3)

13. There is sufficient space within the inner harbor to expand the town marina by approximately 250 boats without encroaching on any marshland adjacent to the harbor. Additionally, Sesuit Harbor Marina has been permitted to construct a new bulkhead which would allow for expansion of 50 boat slips for a total of 300 potential new boats. It is anticipated that growth with the project would be in the order of 200 boats over a 10-year period. Like many other recreational boating harbors, Sesuit Harbor has a waiting list of boat owners looking for berthing space. In view of the demand for boating access to deeper harbors, it is anticipated that with improvement 100 boats would be added to the fleet within two years following project construction. The corresponding annual benefits for new boats purchased immediately amount to \$81,200 annually. (See Table F-4)

14. The remaining expansion of 200 boats would be added gradually over the next 8 years based on economic growth of the area. This growth is based on other improved harbors of the region; it represents a growth of 25 boats per year and appears reasonable. Benefits for this increase have been computed to be \$121,100 based on an equivalent annual growth rate at 6-7/8 percent interest. Without harbor improvement, the fleet would expand at a slower but steady rate due to the constant demand for additional space. This growth rate over a 25-year period amounts to 150 new boats. Benefits reduced to gradual growth rate at the same interest amount to 51,900. (See Table F-6) This amount is deducted from the gross benefits for new boats with the project to provide a total net benefit with improvement of \$69,200 annually. (See Table F-5)

15. Since there are no nearby harbors suitable for mooring recreational boats, it is assumed that no new boats from this source would be transferred to Sesuit Harbor. Local interests have stated that the two launching ramps are used by transient craft for which season and daily stickers can be purchased. In 1973 the town issued 257 season permits for use of these ramps. Assuming that these permit holders use their boats approximately 25 percent of the total days in the season, the equivalent existing locally based transient fleet is equal to 65 boats. There were also 1,406 day users at these ramps in 1973, which is equivalent to 11 permanently based boats for a total existing transient fleet equivalent to 76 locally based craft. Benefits to these craft have been computed on the same basis as the local fleet and amount to \$2,300 annually. (See Table F-7)

16. Growth of the transient fleet using Sesuit Harbor is expected to occur over a 25 year period with project improvement. The growth would be equal to the size of the existing equivalent transient fleet, 76 boats. Growth without the project would be about one-half of the existing equivalent fleet, 37 boats. Thus, the net annual benefit derived for the prospective transient fleet, with allowance for expansion without the improvement, is \$11,900. (See Tables F-8 and F-9)

TABLE F-3 BENEFITS TO RECREATIONAL BOATING

EXISTING FLEET

HARBOR:

TYPE OF CRAFT	LENGTH (feet)	# of Boats	DEPRECIATED VALUE		PERCENT RETURN				VALUE \$	ON CRUISE		
			Average \$	Total \$	Ideal	% of Ideal		Gain		Avg. Days	% of Season	Value \$
						Pres.	Fut.					
RECREATIONAL FLEET												
Outboards	15-20	90	3,100	279,000	13	85	90	0.65	1,814			
	21&Up	7	5,500	38,500	13	80	85	0.65	250			
Sterndrive	15-20	28	5,400	151,200	12	85	90	0.6	907			
	21-25	34	8,800	302,600	11	80	85	0.55	1,664			
	26&Up	10	15,350	153,500	10	70	80	1.0	1,535			
Inboards	15-20	12	5,900	70,800	12	80	90	1.2	850			
	21-30	99	12,900	1,277,100	12	75	85	1.2	15,325	10	8	1226
	31-40	20	31,100	622,000	10	65	80	1.5	9,330	21	16	1493
	41-50	-	84,150	-								
	51-Up	-	252,100	-								
Cruising Sailboats	15-20	19	4,700	89,300	9	80	90	0.9	804			
	21-30	26	11,950	310,700	8	75	85	0.8	2,486	10	8	199
	31-40	4	32,550	130,200	7	65	80	1.0	1,302	21	16	208
	41&Up	-	85,550	-								
Daysailers	8-15	9	1,100	9,900	12	80	90	1.2	119			
	16-20	7	2,700	18,900	11	75	85	1.1	207			
	21-25	-	5,600	-								
	26&Up	-	8,600	-								
TOTALS		365		\$3,453,700					\$36,593			\$3,126

Annual Net Benefit
 $\$36,593 - 3126 = \$33,467$

Say \$33,500

New England Boating Season

Maine 95 days

N.H. 110 days

Mass 130 days

R.I. 170 days

Conn 160 days

TABLE F-4 BENEFITS TO RECREATIONAL BOATING

Boats Immediately Added

HARBOR:													
TYPE OF CRAFT	LENGTH (feet)	# of Boats	DEPRECIATED VALUE		PERCENT RETURN				VALUE \$	ON CRUISE			
			Average \$	Total \$	Ideal	% of Ideal		Gain		Avg. Days	% of Season	Value \$	
						Pres.	Fut.						
RECREATIONAL FLEET													
Outboards	15-20	25	3,100	77,500	13	0	90	11.7	9,068				
	21&Up	2	5,500	11,000	13	0	85	11.0	1,210				
Sterndrive	15-20	8	5,400	43,200	12	0	90	10.8	4,666				
	21-25	9	8,900	79,200	11	0	85	9.4	7,445				
	26&Up	3	15,350	46,050	10	0	80	8.0	3,684				
Inboards	15-20	4	5,900	23,600	12	0	90	10.8	2,549				
	21-30	27	12,900	348,300	12	0	85	10.2	35,527	10	8	2842	
	31-40	5	31,100	155,500	10	0	80	8.0	12,440	21	16	1990	
	41-50	-	84,150	-									
	51-Up	-	252,100	-									
Cruising Sailboats	15-20	5	4,700	23,500	9	0	90	8.1	1,903				
	21-30	7	11,950	83,650	8	0	85	6.8	5,688	10	8	455	
	31-40	1	32,550	32,550	7	0	80	5.6	1,825	21	16	292	
	41&Up	-	85,550	-									
Daysailers	8-15	2	1,100	2,200	12	0	90	10.8	238				
	16-20	2	2,700	5,400	11	0	85	9.4	508				
	21-25	-	5,600										
	26&Up	-	8,600										
TOTALS		100		\$931,650					\$86,749			\$5,579	

Annual Net Benefit

\$86,749 - 5579 = \$81,170

Say \$ 81,200

TABLE F-5 BENEFITS TO RECREATIONAL BOATING

FUTURE GROWTH WITH PROJECT (10 YRS)

HARBOR:

TYPE OF CRAFT	LENGTH (feet)	# of Boats	DEPRECIATED VALUE		PERCENT RETURN				VALUE \$	ON CRUISE		
			Average \$	Total \$	Ideal	% of Ideal Pres. Fut.	Gain	Avg. Days		% of Season	Value \$	
RECREATIONAL FLEET												
Outboards	15-20	50	3,100	155,000	13	0	90	11.7	18,135			
	21&Up	4	5,500	22,000	13	0	85	11.0	2,420			
Sterndrive	15-20	16	5,400	86,400	12	0	90	10.8	9,331			
	21-25	18	8,800	158,400	11	0	85	9.4	14,890			
	26&Up	6	15,350	92,100	10	0	80	8.0	7,368			
Inboards	15-20	8	5,900	47,200	12	0	90	10.8	5,098			
	21-30	54	12,900	696,600	12	0	85	10.2	71,053	10	8	5684
	31-40	10	31,100	311,000	10	0	80	8.0	24,880	21	16	3981
	41-50	-	84,150	-						-		
	51-Up	-	252,100	-						-		
Cruising Sailboats	15-20	10	4,700	47,000	9	0	90	8.1	3,807			
	21-30	14	11,950	167,300	8	0	85	6.8	11,376	10	8	910
	31-40	2	32,550	65,100	7	0	80	5.6	3,646	21	16	583
	41&Up	-	85,550	-								
Daysailers	8-15	4	1,100	4,400	12	0	90	10.8	475			
	16-20	4	2,700	10,800	11	0	85	9.4	1,015			
	21-25		5,600									
	26&Up		8,600									
TOTALS		200		\$1,863,300					\$173,494			\$11,158

$$\text{Annual Net Benefit} \\ (\$173,494 - \$11,158)(.7458)^* = \$121,070$$

Say \$121,100
 Less 51,900 (From Table F-6)
\$ 69,200 Net Future Growth

*Avg. Annual Equivalent Factor
 50 yr. life, 10 yr. growth 6 7/8%

TABLE F-6 BENEFITS TO RECREATIONAL BOATING

FUTURE GROWTH WITHOUT PROJECT (25 YRS.)

HARBOR:

HARBOR:												
TYPE OF CRAFT	LENGTH (feet)	# of Boats	DEPRECIATED VALUE		PERCENT RETURN				VALUE \$	ON CRUISE		
			Average \$	Total \$	Ideal %	% of Ideal		Gain		Avg. Days	% of Season	Value \$
						Pres.	Fut.					
RECREATIONAL FLEET												
Outboards	15-20	38	3,100	117,800	13	0	85	11	12,958			
	21&Up	4	5,500	22,000	13	0	80	10.4	2,288			
Sterndrive	15-20	12	5,400	64,800	12	0	85	10.2	6,610			
	21-25	14	8,800	123,200	11	0	80	8.8	10,842			
	26&Up	4	15,350	61,400	10	0	70	7.0	4,298			
Inboards	15-20	6	5,900	35,400	12	0	80	9.6	3,398			
	21-30	40	12,900	516,000	12	0	75	9.0	46,440	10	8	3715
	31-40	7	31,100	217,700	10	0	65	6.5	14,150	21	16	2264
	41-50	-	84,150	-								
	51-Up	-	252,100	-								
Cruising Sailboats	15-20	7	4,700	32,900	9	0	80	7.2	2,369			
	21-30	11	11,950	131,450	8	0	75	6.0	7,887	10	8	631
	31-40	1	32,550	32,550	7	0	65	4.6	1,497	21	16	240
	41&Up	-	85,550	-								
Daysailers	8-15	3	1,100	3,300	12	0	80	9.6	317			
	16-20	3	2,700	8,100	11	0	75	8.3	672			
	21-25		5,600									
	26&Up		8,600									
TOTALS		150		\$1,366,600					\$113,726			\$6,850

$$\frac{\text{Annual Net Benefit}}{(\$113,726 - 6850)(.4853 *) = \$ 51,867}$$

Say \$ 51,900

*Avg. Annual Equivalent - 50 yrs. life
25 yrs. growth, 6 7/8%

TABLE F-7 BENEFITS TO RECREATIONAL BOATING

EXISTING EQUIVALENT TRANSIENT FLEET

HARBOR:

TYPE OF CRAFT	LENGTH (feet)	# of Boats	DEPRECIATED VALUE		PERCENT RETURN				VALUE \$	ON CRUISE		
			Average \$	Total \$	Ideal	% of Ideal	Gain			Avg. Days	% of Season	Value \$
RECREATIONAL FLEET	10-14	15	2,830	42,450	13	95	100	0.6	254			
Outboards	15-20	20	3,100	62,000	13	85	90	0.65	403			
	21&Up	5	5,500	27,500	13	80	85	0.65	178			
Sterndrive	15-20	20	5,400	108,000	12	85	90	0.6	648			
	21-25	16	8,800	140,800	11	80	85	0.55	774			
	26&Up		15,350									
Inboards	15-20		5,900									
	21-30		12,900									
	31-40		31,100									
	41-50		84,150									
	51-Up		252,100									
Cruising Sailboats	15-20		4,700									
	21-30		11,950									
	31-40		32,550									
	41&Up		85,550									
Daysailers	8-15		1,100									
	16-20		2,700									
	21-25		5,600									
	26&Up		8,600									
TOTALS		76		\$380,750					\$2,257			

Annual Net Benefit - \$ 2,300

TABLE F-8 · BENEFITS TO RECREATIONAL BOATING

FUTURE EQUIVALENT TRANSIENT FLEET (WITH PROJECT)

HARBOR:												
TYPE OF CRAFT	LENGTH (feet)	# of Boats	DEPRECIATED VALUE		PERCENT RETURN				VALUE \$	ON CRUISE		
			Average \$	Total \$	Ideal	% of Ideal		Gain		Avg. Days	% of Season	Value \$
						Pres.	Fut.					
RECREATIONAL FLEET	10-14	12	2,830	33,960	13	0	100	13	4,414			
Outboards	15-20	18	3,100	55,800	13	0	90	11.7	6,529			
	21&Up	10	5,500	55,000	13	0	85	11.0	6,050			
Stern drive	15-20	15	5,400	81,000	12	0	90	10.8	8,748			
	21-25	20	8,800	176,000	11	0	85	9.4	16,544			
	26&Up	1	15,350	15,350	10	0	80	8.0	1,228			
Inboards	15-20		5,900									
	21-30		12,900									
	31-40		31,100									
	41-50		84,150									
	51-Up		252,100									
Cruising Sailboats	15-20		4,700									
	21-30		11,950									
	31-40		32,550									
	41&Up		85,550									
Daysailers	8-15		1,100									
	16-20		2,700									
	21-25		5,600									
	26&Up		8,600									
TOTALS		76		\$417,110					\$43,513			

Annual Benefit (\$43,513)(0.4853)* = \$ 21,117
 Less Future Growth = 9,500 (Table)
 w/o project
 Net Annual Benefit \$ 11,617
 Say \$ 11,600

*Avg. Annual Equivalent
 50 yr. life
 25 yr. straight line growth 6 7/8%

TABLE F-9 BENEFITS TO RECREATIONAL BOATING
FUTURE EQUIVALENT TRANSIENT FLEET (WITHOUT PROJECT)

HARBOR:												
TYPE OF CRAFT	LENGTH (feet)	# of Boats	DEPRECIATED VALUE		PERCENT RETURN				VALUE \$	ON CRUISE		
			Average \$	Total \$	Ideal	% of Ideal		Gain		Avg. Days	% of Season	Value \$
						Pres.	Fut.					
RECREATIONAL FLEET	10-14	6	2,830	16,980	13	0	90	11.7	1,987			
Outboards	15-20	9	3,100	27,900	13	0	85	11.0	3,069			
	21&Up	5	5,500	27,500	13	0	80	10.4	2,860			
	15-20	7	5,400	37,800	12	0	85	10.2	3,856			
Stern drive	21-25	10	8,800	88,000	11	0	80	8.8	7,744			
	26&Up		15,350									
	15-20		5,900									
Inboards	21-30		12,900									
	31-40		31,100									
	41-50		84,150									
	51-Up		252,100									
	15-20		4,700									
Cruising Sailboats	21-30		11,950									
	31-40		32,550									
	41&Up		85,550									
	8-15		1,100									
Daysailers	16-20		2,700									
	21-25		5,600									
	26&Up		8,600									
	TOTALS		37		\$198,180					\$19,516		

Annual Benefit (\$19,516 x .4853 * = \$ 9,471
 Say \$ 9,500

*Avg. Annual Equivalent
 50 yr. life
 25 yr. growth
 6-7/8% interest

17. The proposed improvement will provide for more efficient utilization of the harbor. As previously discussed, much of the regional economy is dependent upon the recreational boating use of Sesuit Harbor. The availability of adequate berthing facilities will permit expansion of commercial enterprises generating employment and tax revenues to the town of Dennis.

18. The estimated annual costs, estimated annual benefits, and the ratio of benefits to costs, summarized in Table F-8, indicate that the plan to improve the entrance channel at Sesuit Harbor is economically justified.

TABLE F-10

Summary of Economic Analysis

<u>Item</u>	<u>Amount</u>
Average Annual Benefits	\$198,100
Average Annual Costs	45,100
Economic Ratio - Benefits/Cost	4.4

**SESUIT HARBOR
DENNIS, MASSACHUSETTS**

**DETAILED PROJECT REPORT
CHANNEL MODIFICATION FOR NAVIGATION**

ENVIRONMENTAL ASSESSMENT

APPENDIX 2

**PREPARED BY THE
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION**

ENVIRONMENTAL ASSESSMENT

SESUIT HARBOR, DENNIS, MASSACHUSETTS

PROPOSED IMPROVEMENT DREDGING

1.00. INTRODUCTION

1.01. In keeping with the National Environmental Policy Act of 1969, The New England Division Army Corps of Engineers has examined environmental values as part of the planning and development of the proposed action plan. Background environmental information was compiled for proposal of this report through interviews with various state and local interest groups and a search of published literature. This report provides an assessment of environmental impacts and alternatives considered and contains other applicable data to the Section 404 Evaluation requirements.

2.00. PROJECT DESCRIPTION

2.01. The objective of the proposed project is to conduct improvement dredging in Sesuit Harbor. The dredging will alleviate shoal conditions in the entrance channel. The improved channel will provide safer navigation for recreational boats using the harbor, eliminate tidal delays and encourage further development of boating facilities within the harbor.

2.02. The proposed improvement dredging will consist of removing an estimated 40,000 cubic yards of fine to medium sand from an area approximately 2,400 feet long and varying in width from 100 to 80 feet through the harbor entrance. All material will be removed by hydraulic dredge to a minimum depth of 6 feet below mean low water. Maintenance frequency is estimated at five (5) year intervals with an annual shoaling rate of 6,000 cubic yards. The project was last dredged by the Commonwealth during September 1976 when 20,000 cubic yards were removed and placed on the beach east of the channel.

2.03. Dredged sand from Sesuit Harbor is suitable for both ocean disposal and beach nourishment. In light of recent Corps policy guideline stressing priority be given to beach nourishment when dredged material is suitable, this method of disposal will be followed. Studies indicate that from a point approximately 500 feet west of the west jetty longshore currents would move the dredged sand away from the channel entrance. Therefore, the sand will be discharged along the beach from a point approximately 500 feet west of the west jetty. The beach in this area is partially owned by the Town of Dennis. The remainder of this is privately owned. (See Plate D-1, Site A in Appendix 1.)

3.00 ENVIRONMENTAL SETTING AND NATURAL RESOURCES

3.01. Sesuit Harbor is located on the north side of Cape Cod, in the town of Dennis, about five miles eastward of Barnstable Harbor and about eight miles southwest of Wellfleet Harbor. The harbor forms the mouth of Sesuit Creek, a narrow winding stream which drains a 165-acre salt marsh extending south and west of the harbor entrance. The adjacent shoreline both east and west of the entrance consists of moderately wide sandy beaches interspersed with boulders and bed-rock outcrops. These beaches are used by local residents for recreational bathing.

3.02. Sesuit Harbor is about 3,500 feet long, averaging 500 feet in width with controlling depths ranging from 2 to 8 feet in the dredged portions. The mean tide range is 9.5 feet and the spring range is 11.0 feet. During severe winter conditions, the harbor is iced in for periods of 1 to 2 months. The climate of the area is temperate, with temperatures ranging from a mean of 31.7 degrees F. in January to 71.1 degrees F. in July. Mean annual precipitation, mostly in the form of rain, is 40.58 inches.

3.03. The town of Dennis is located about midway across the southern arm of Cape Cod. It is about 85 miles from Boston, Massachusetts and 260 miles from New York City. The coastal areas of Dennis are dominated by marshland fronted by barrier beaches. The interior is almost entirely sandy loam covered with thin strands of hardwood timber and brush. The land formations are comparatively level with maximum elevations of not more than 100 feet running along low hills on the north coast. There are several small ponds in the hilly area and larger ponds in the south. The Town has a tidal shoreline of 29.8 miles.

3.04. The harbor currently supports a small commercial fishing fleet consisting of two trawlers, six lobster boats, one scalloper and five charter sport fishing boats. Sesuit represents the only harbor of refuge for recreational and commercial craft between the Cape Cod Canal and Wellfleet Harbor.

4.00. RELATIONSHIP OF THE PROPOSED ACTION TO LAND USE PLANS

4.01. Disposal of the dredged material along the beach (Site A) will alter the existing topography of approximately 800 feet of shoreline and adjacent intertidal waters. The addition of the sandy material will enhance the area, albeit temporarily, as a recreational swimming beach.

5.00. ENVIRONMENTAL IMPACTS ASSOCIATED WITH THE PROPOSED ACTION

5.01. Impacts of the proposed project will have not only short term impacts but also longer term implications. Physical activities associated with the actual dredging and disposal operations will have shorter term effects on the water column and the benthic community. Longer term impacts include impacts on the cultural, economic, recreational, and aesthetic resources of the general project area. Table I is a summary of the potential impacts that are likely to occur should the project be implemented. This table is divided into three arbitrary time frames for the potential impacts.

5.02. Sediment and Water Quality. Most of the impacts identified center on short term effects related to the physical activities of dredging and disposal. Of particular importance is the quality of the sediment to be dredged.

5.03. EPA guidelines (1977) recommend several tests to be used to determine if material to be dredged is classified as polluted or nonpolluted, and to indicate if further sedimentological data collection is necessary. The Corps of Engineers (NED) conducted sedimentological tests in 1974, the results of which are shown on Table II. Chemical analysis shows the project area is relatively unpolluted. Levels of dissolved oxygen and turbidity in the waters of Sesuit Harbor will be affected by the dredging and disposal operations. Short term increases in turbidity around the cutter head of the dredge will result from suspended sediments stirred up by the operation. Dissolved oxygen levels will be temporarily suppressed since small amounts of resuspended organic sediments will require oxygen for bacterial decomposition. This suppression will have little impact on the overall water quality.

The minor concentrations of toxic heavy metals and other chemicals should have no great effect on resident or migratory biota. Populations of organisms within the harbor environment would be at its lowest activity level during the colder months when dredging would be performed. There are no usable groundwater resources in the disposal areas which could be affected. An additional five grab samples were obtained in January 1978 to ascertain the sediment type and distribution. The results showed sand to be the dominant sediment in the proposed dredge area.

5.04. Dredging and Disposal. The dredging of the channel and the disposal of the dredged material on land will affect both marine and terrestrial organisms. Removal of the bottom materials in the channel will temporarily reduce the number of bottom dwelling organisms which cannot evacuate the dredging site. Macrobenthic organisms identified in the harbor include hard and soft shell clams, scallops and mussels. Based on similar dredging project studies, it appears that dredging operations will physically destroy biological communities in the path of the dredge. As the habitat is destroyed, these organisms will be removed and redistributed or destroyed. Destruction will be maximal in the channel, while some slight effects can be expected in adjacent areas. Localized effect on in-fish as a result of increased turbidities are expected. However, adult fin-fish should easily avoid the dredging area. Since the project is consolidated within a small area, adverse impacts on ecological systems will have no lasting long term effects.

5.05. Disposal of material on the beach will destroy little flora. However, care should be taken to avoid placing the dredged material on the steep bank immediately behind the beach. This area is presently vegetated by a typical coastal sand dune population that helps to stabilize the sandy soil and prevent wind erosion.

5.06. Materials placed on the proposed beach and intertidal zone will be subject to redistribution by local tidal currents and storm wave activity. There is some question as to the direction of littoral drift. An early report by Woodworth (1934)* shows the location of Sesuit Harbor to be in the vicinity of a convergence zone for west and east longshore drift characterizing Cape Cod Bay. The drift to the west side of the channel, where the dredged sediments are to be deposited is thought to be to the west toward the Cape Cod Canal. Regardless of direction, during periods of northwest winds or north-east storms it would seem reasonable to assume that some of the sediments may be transported back into the channel necessitating dredging under the normal four year maintenance frequency period.

*Part III. Geology of Cape Cod and the Elizabeth Islands, Chapter 1 by J.B. Woodworth. Memoirs of the Museum of Comparative Zoology, Harvard College, Vol. II, 1934.

5.07. Cultural Resources.

5.08. There are no known cultural resources in the project area. A review of the National Register of Historic Places revealed no properties or sites listed or eligible for listing. Coordination with the State Historic Commission did indicate the presence of a known archaeological site on Sesuit Neck. This site is further inland and outside the impacts of this project.

5.09. The dredging operation itself will have no adverse impacts on cultural resources since the harbor has been previously dredged to approximately the same dimensions. It is also unlikely that the placement of sand on a nearby beach for the purpose of beach nourishment will have any adverse impacts. If, however, heavy equipment is used in the process, there could be potential impacts.

5.10. Air Quality. As a result of the improvement, vessel and vehicle traffic is expected to increase causing an increase in air pollution levels. Dusty conditions could result from wind erosion in the disposal areas. Marine odors will be evident during disposal of the dredged materials and for a short time during the drying period. However, it is anticipated that these odors will be worse than those experienced during low tide periods under existing conditions.

6.00. ADVERSE ENVIRONMENTAL IMPACTS WHICH CANNOT BE AVOIDED

6.01. The short term environmental impacts described in Section 5.00, i.e., increases in turbidity the suspension of material and possible odors, cannot be avoided if the dredging project is undertaken. The dredging operation will remove and/or destroy attached, burrowing and some of the less motile benthic invertebrates inhabiting the channel. Likewise, deposit of the material on the beach and intertidal area west of the channel will destroy the meiofauna associated with the existing beach sands and attached animal and plant communities found on the rocks also characterizing the disposal site. Species composition and numbers of benthic invertebrates will be altered due to smothering and other physical changes. Repopulation of the channel should be fairly rapid as the substrate type will not be permanently changed. The turbidity and subsequent resettling of suspended material is expected to be minimal and localized due to the sandy, nature of the sediments in Sesuit channel.

6.02. The location of the project appears to be at the convergence of north to northeast and northwest longshore drift patterns which will have a definite determination in the permanency of the deposited dredged sands. The transport of the material will influence the maintenance dredging frequency. According to representatives of the

Massachusetts Division of Waterways, the predominant transport of sediments is from east to west. However, during northeast storms this pattern may be interrupted.

7.00. ALTERNATIVES

To satisfy the need for improvement of Sesuit Harbor, a basic problem must be solved; that is, the elimination of tidal delays and groundings by providing a deeper channel. This would allow for the addition of more berthing spaces to meet the existing and future demands of recreational boating in the town of Dennis. Three alternatives exist:

- Develop new facilities at some other site.
- Modify existing conditions.
- Make no improvement at this time.

7.01. Summary of Possible Solutions. Sesuit Harbor is the only site between Cape Cod Canal and Wellfleet Harbor which is sufficiently developed for use by recreational boats to be worthy of further improvement without vast investment in new facilities. Movement of the fleet to new sites would be impractical, since a protected harbor is already available. Relocation would require extensive land takings in seasonal residence areas and encroachment upon prime recreational lands. Further study of alternatives involving movement outside Sesuit Harbor has therefore been discontinued. Modification of existing facilities is, however, feasible. Channel improvements within the harbor will increase the efficiency of the harbor to meet future demands for expansion.

7.02. Alternatives Considered Further. Discussion of alternatives, thus far, has been based on the premise that there is a need to relieve congestion and access to the harbor. Alternatives considering expansion into areas outside Sesuit Harbor have proven to be impractical. A "no improvement" alternative is contrary to local regional planning. Further consideration of possible alternatives will be limited to modifications to existing waterways as requested by local interests.

7.03. Disposal Alternatives For Ocean Disposal. The proposed improvements to the entrance channel at Sesuit Harbor involves material disposal methods which would be most economical and still cause the least disruption to the environment. Generally, disposal involves the use of bucket dredges and bottom dump scows for hauling the material to offshore disposal sites. Bucket dredging methods may cause less turbidity at both dredging site and disposal site than

hydraulic methods. Also, offshore disposal sites must be chosen where the least damage to marine organisms will occur. These disposal sites have been found to be too far away from the project site for economical hauling of material. The nearest dumping site is the Cape Cod Bay disposal site near Sandwich which has been approved by the Commonwealth as a disposal site for "clean" dredge spoil. The site is a one-mile circle centered at 41°49'N and 70°25'W and is northeast of Sandwich. Waters are more than 70 feet deep at the site. This site has, for some time, received the dredged sediments from the northern portion of the Cape Cod Canal. The site, however, has yet to be formally designated by the U.S. Environmental Protection Agency.

7.04. Utilization of this disposal site and nearby areas by fishermen is not reported to be heavy. Trawlers, however, have been known to complain about the presence of buoys accurately defining the disposal site. The area is closed to trawlers from May 1st to October 31st because of conflict with recreational boating. Some lobstering is carried on in the region, but it is not intensive, nor is it in conflict with disposal operations which have taken place. Dumping of dredged material anywhere in Cape Cod Bay is subject to the provisions of the Massachusetts Ocean Sanctuary Act under the jurisdiction of the Commonwealth.

7.05. Land Disposal. Disposal on land at other locations would require substantial diking of the disposal areas by local interests prior to dredging operations. It would also require an area of at least 6 acres where all dredged material would be placed to maximum depth of 4 feet. This is the smallest disposal area which could be utilized using hydraulic dredging methods. Maximum horizontal pumping distance without a booster pump would be limited to approximately 5,000 feet from the dredging site. A booster pump would nearly double the cost of dredging disposal. Land use around Sesuit Harbor precludes the possibility of obtaining a disposal site of this magnitude without serious disruption of the social and environmental aspects of the area. An investigation was made on 18 October 1977 of four (4) potential land and beach sites as a possible repository for the dredged material.

7.06. The potential disposal areas examined are shown on Plate D-1. A species inventory of the plants characterizing each site was conducted. Site "C" consists of wetlands and is part of a town conservation area. The Conservation Commission indicated quite emphatically that they would disapprove any disposal plans at this site; therefore, it should be dropped from further consideration.

7.07. Site "D" is a small remnant wetland area dominated by Spartina patens and Spartina alterniflora. This site is too small to accommodate the quantity of material estimated to be dredged from the improvement action. Its location is also further remote from dredge area than either sites A and B so it is not as economically attractive. Fill to provide a parking area for the marina has encroached upon this wetlands and has reduced its value.

7.08. Site "B" consists of sand dune habitat with a variety of plant life. The site could accommodate some but not all of the dredged material. Disposal at this site would destroy all existing vegetation. A state maintenance dredging action completed last year pumped the dredged material immediately seaward of this site. Some of the sediments have been washed down into the area. The Conservation Commission is hesitant about utilizing this site. The area was originally considered for disposal of 4,000 cubic yards of silty sediment thought to be in the area of the dredge operation. Sediment samples taken in January 1978 confirmed the presence of sands, therefore this site is no longer needed for disposal purposes at this time.

7.09. Site "A" appears to be the best alternative for disposal purposes. This site consists of both sand and rocky beach habitats - privately owned. There is some 800 feet of beach-front extending from west jetty to an access road off Bridge Street. This area could accept the total 40,000 cubic yards estimated to be dredged and even more. Easements will have to be obtained from the residence property owners.

8.00. COORDINATION

8.01. A public meeting on the navigation improvements in Sesuit Harbor, Dennis, Massachusetts, was held 29 November 1977. Prior to the meeting, Corps biologist met with local interests on 18 October 1977 to discuss environmental aspects of disposal of dredged material and to examine and evaluate potential land on beach disposal areas.

8.02. The project is being coordinated with the major federal and state regulatory agencies represented by the U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, National Marine Fisheries Service and Massachusetts Division of Marine Fisheries.

These agencies as well as local officials from the town of Dennis were notified of the proposed dredging operation schedule and plans. Copies of commenting letters received in response to the proposed improvement dredging work are attached to this environmental assessment.

8.03. Questions or comments relating to this assessment report should be directed to the Chief, Environmental Analysis Branch, New England Division, U.S. Army Corps of Engineers.

8.04. Prior to the commencement of any work, a public notice will be issued outlining the proposed action plan. Comments by all interested persons and agencies may be submitted to the Corps for a thirty-day period following release of this notice.


CONCLUSIONS

Upon evaluating the information presented in this Environmental Assessment Report, it is my belief that the proposed improvement dredging of the portion of Sesuit Harbor indicated is in the best public interest. The proposed work will be reviewed under Section 313 and 404 of the Federal Water Pollution Control Act, commonly referred to as the Clean Water Act which was enacted 28 December 1977.

Except for temporary water quality effects, it has been determined that adverse environmental impacts will be minimal. The Dennis Beach Commission has requested that (a) no work be done during the period from 1 May to Labor Day so not to interfere with the swimming and recreational boating season and (b) no dredged material be placed on or above the vegetation line along the beach. The town selectmen have also requested that the alignment of the channel conform to the existing natural channel which is located along the east side of the entrance. The Corps of Engineers will comply with requirements set forth in the Clean Water Act prior to initiating work on the project. The project is being coordinated with the U. S. Fish and Wildlife Service, National Marine Fisheries Service, Massachusetts Executive Office of Environmental Affairs, and the Town of Dennis.

In my evaluation, this assessment has been prepared in accordance with the National Environmental Policy Act of 1969 and will be coordinated with appropriate regulatory agencies. Based on the scheduling of the actual work and previous monitoring investigations, it appears that the dredging can be conducted with minimal environmental impacts. The assessment therefore precludes the need for preparation of a formal Environmental Impact Statement at this time.

8 November 1978
(Date)


JOHN P. CHANDLER
Colonel, Corps of Engineers
Division Engineer

2 Incl
as

TABLE I

SUMMARY OF POTENTIAL IMPACTS

POTENTIAL ENVIRONMENTAL IMPACTS	TIME FRAMES OF POTENTIAL IMPACTS		
	VERY SHORT TERM (Days to Weeks)	SHORT TERM (Weeks to Months)	LONG TERM (Years)
Impacts on Aquatic Ecosystems	<ul style="list-style-type: none"> .Suspension of material in water column. .Temporary loss of water quality due to dredging. .Temporary loss of water quality due to effluent discharge. .Loss of benthic organisms in dredge area. .Potential localized effects on finfish 	<ul style="list-style-type: none"> .Release of nutrients in water column. .Temporary loss of water due to effluent discharge. .Temporary disruptions of benthic organisms until recolonization occurs. .Possible localized effects on finfish. 	<ul style="list-style-type: none"> .Physical removal of benthic substrate from channel dredge site. .Benthic organisms become re-established.
Impacts on Terrestrial Ecosystems	<ul style="list-style-type: none"> .Loss of habitat at Site B 	<ul style="list-style-type: none"> .Loss of habitat at Site B. .Potential erosion of dikes and subsequent effects on terrain and/or marsh area. .Potential leaching out of chemicals from dredged material into groundwater. 	<ul style="list-style-type: none"> .Colonization of settling site B by flora and associated fauna.

TABLE I (cont)

SUMMARY OF POTENTIAL IMPACTS

POTENTIAL ENVIRONMENTAL IMPACTS	TIME FRAMES OF POTENTIAL IMPACTS		
	VERY SHORT TERM (Days to Weeks)	SHORT TERM (Weeks to Months)	LONG TERM (Years)
Impacts on Local, Human Environment	<ul style="list-style-type: none"> .Temporary reduction in visual aesthetic value of water column due to dredging and discharge. .Temporary offensive odor of dredged material at settling site or beach disposal area. 	<ul style="list-style-type: none"> .Temporary localized reduction in visual aesthetic value of water near effluent discharge/ 	<ul style="list-style-type: none"> .Potential increase in docking facilities for commercial and .Improvement in navigation. .Stimulation of economic growth of area.

TABLE II - SESUIT HARBOR
1974 - SEDIMENT SAMPLE TEST RESULTS

<u>PARAMETERS</u>	<u>PE-1</u>	<u>PE-6</u>	<u>PE-7</u>
Visual Classif.	Blk., Fine Sandy Organic Silt w/algae	Tan & Grey Fine Sand	Tan and Grey Fine Sand
Grain Size (Med)	-----	0.26	0.23
Spec. Grav. Solids	2.55		
Wet WGT	93.5		
Dry WGT	48.7		
Percent Solids	50.24 (53.63)		
% Vol. Solids - EPA	5.82 (5.73)		
- NED	4.79		
COD	96500		
TKN	2010		
Oil & Grease	2490		
Hg	0.19 (.085)		
Pb	12 (22)		
Zn	42 (41)		
As	2.4 (3.5)		
Cd	0.8 (0.8)		
Cr	16 (10)		
Cu	40 (30)		
Ni	12 (11)		
V	28 (26)		
% Total Carbon	1.90		
% Hydrogen	0.29		
% Nitrogen	0.21		
DDT (ppb)	9.0		
Plychl Biph (ppb)	68.0		

NOTE: All values are expressed as ppm unless otherwise noted and those figures in parenthesis indicate metal concentration for CORE depth of 1.0 - 1.17 ft.

**SESUIT HARBOR
DENNIS, MASSACHUSETTS**

**DETAILED PROJECT REPORT
CHANNEL MODIFICATION FOR NAVIGATION**

SOCIO-ECONOMIC ASSESSMENT

APPENDIX 3

**PREPARED BY THE
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION**

SOCIAL AND ECONOMIC EFFECTS ASSESSMENT

SESUIT HARBOR

DENNIS, MASSACHUSETTS

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1.00 INTRODUCTION

1.01. Sesuit Harbor is located on the north side of Cape Cod, in the town of Dennis. It is one of four small natural harbors on the north side of Cape Cod between the Cape Cod Canal on the west and Wellfleet Harbor on the outer arm of the Cape.

1.02. Historically, the north side of Cape Cod has served as the home base of small commercial fishing fleets. Due to shoals at the entrance to Sesuit Harbor, it has not received the commercial fishing use experienced by deeper draft harbors such as Wellfleet and Provincetown.

1.03. However, Sesuit Harbor has become crowded with recreational craft, nearly exhausting available mooring spaces. Because of shoaling, recreational boat operators using Sesuit Harbor have been experiencing navigation difficulties in negotiating the existing entrance channel. Many operators have sustained damages from grounding during passage under adverse weather conditions. Shoaling of the channel has resulted in tidal delays. Nevertheless, there are several sites within the harbor which could be developed to increase its mooring capacity.

1.04. Presently, a detailed engineering and economic study is being made to determine the need and justification for constructing navigation improvements in Sesuit Harbor. The planning process requires consideration of other alternatives as well. This phase of the study is concerned with social and economic elements that may be affected by implementation of a project.

2.00. THE STUDY AREA

2.10. POPULATION CHARACTERISTICS

2.11. During the 1960-1970 decade, the population of Dennis increased 73.2% from 3,727 to 6,454, while the population of Barnstable County expanded by 37.5%. Prior to this decade, population of Dennis and the County increased at a similar rate. This rate far exceeded the overall rate for the State. Table 1 details these population increases.

TABLE 1
POPULATION

	<u>Dennis</u>	<u>Barnstable County</u>	<u>State of Massachusetts</u>
1970	6,454	96,656	5,689,170
% Chg. Over Prev. Decade	73.2	37.5	10.5
1960	3,727	70,286	5,148,578
% Chg. Over Prev. Decade	49.1	50.2	9.8
1950	2,499	46,805	4,690,514
% Chg. Over Prev. Decade	24.0	25.5	8.7
1940	2,015	37,295	4,316,721
% Chg. Over Prev. Decade	10.2	15.4	1.6
1930	1,829	32,305	4,249,614

Source: Town and City Monographs

2.12. All age group categories showed a substantial increase over the 1960-70 decade. The greatest increase by age group category was recorded by the 65 and over age group with an increase of 82.6% between 1960 and 1970. This age group made up 24% of the total population, not a significant difference from the 1960 proportion. Table 2 shows these changes for each category for both Dennis and Barnstable County.

TABLE 2
AGE GROUP DISTRIBUTIONS

<u>Age Group</u>	<u>Dennis</u>			<u>Barnstable County</u>		
	<u>1960</u>	<u>1970</u>	<u>%Chg.</u>	<u>1960</u>	<u>1970</u>	<u>%Chg.</u>
0-4	309	411	33.0	8423	7122	-15.4
5-14	587	979	66.8	12,303	18,093	47.1
15-64	1984	3517	77.3	40,600	55,093	35.7
65 & Over	<u>847</u>	<u>1547</u>	<u>82.6</u>	<u>8,960</u>	<u>16,348</u>	<u>82.5</u>
TOTALS	3727	6454	73.2	70,286	96,656	37.5

Source: Cape Cod Planning and Economic Development Commission

2.13. Year-round population in Dennis as of 1 January 1974 was 8,620, a total which was exceeded five times during the summer by a peak seasonal population of 51,499. This increase is double the year-round to seasonal increase experienced by Barnstable County. Table 3 details the year-round and seasonal populations for Dennis and Barnstable County from 1970 to 1974.

TABLE 3
YEAR-ROUND AND SEASONAL POPULATIONS
1970-1974

	<u>Year-Round as of 1 Jan *</u>		<u>Seasonal Peak Day, July/Aug**</u>	
	<u>Dennis</u>	<u>Barnstable County</u>	<u>Dennis</u>	<u>Barnstable County</u>
1970	6454	96,656	39,257	350,781
1971	6827	100,879	41,414	364,770
1972	7359	107,721	44,474	385,773
1973	8082	114,216	48,503	407,440
1974	8620	121,258	51,499	428,986

*Year-round population estimates are based on the 1970 census plus estimates of population added each year as indicated by residential building permits issued:

1. Residential units added annually (less 2% allowance for noncompletions) are distributed between year-round and seasonal categories on the basis of each town's 1970 Census Occupancy Rate (proportion of total housing that is occupied year-round).

2. Year-round population added annually is estimated by multiplying the number of new year-round units by the population per unit reported for each town in the 1970 Census.

**Peak Season Population Estimates include year-round population plus occupants of seasonal dwellings (@6.1 per dwelling), public accommodations (@2 per room), trailers and tents, (@4 per site) and overnight camps (@licensed capacity).

2.20. THE ECONOMY

2.21. Historically, Dennis's economy was centered on the fishing industry. Today, as in most Cape Cod communities, the economy is centered around summer residents and tourists. According to the 1970 Census figures, the wholesale and retail trade industry accounts for the largest proportion of total employment of 26.5%. This sector is followed by the services and construction sectors employing 21.4% and 13.7% respectively. Table 4 offers a breakdown of employment by industry.

TABLE 4
EMPLOYMENT BY INDUSTRY
DENNIS, 1970

<u>Industry</u>	<u>Number</u>	<u>% of Total</u>
Construction	283	13.7
Manufacturing	145	7.0
Trans., Comm., Util.	135	6.6
Wholesale/Retail Trade	540	26.2
Finance, Insurance & Real Estate	160	7.8
Services	441	21.4
Public Administration	120	5.8
Other	<u>238</u>	<u>11.5</u>
TOTALS	2062	100.0

Source: U.S. Census

2.30. LAND USE CHARACTERISTICS.

2.31. Of the 22.1 square miles composing Dennis, approximately 48% is covered by forest.* The second most predominant use is residential, taking up about 25% of Dennis's land area. Acreage devoted to residential use more than doubled between 1951 and 1971. This increase resulted in substantial losses in the forest and agriculture sectors. Table 5 provides a breakdown of the major land use categories for 1951 and 1971.

2.32. Most development has occurred along the south shore areas of Dennis, in West Dennis and Dennisport. Commercial use in this area is in the form of "strip development" along Rt. 28. The overwhelming use is of course residential. This is also true for the area surrounding Sesuit Harbor. Development has been intense; there remains very little vacant land suitable for development. The shore areas have been developed for year-round residences and seasonal homes, camps, boat yards and marinas.

*MacConnell, 1971

2.33. In 1970, there was a total of 7,329 housing units in Dennis. Year-round units totaled 4,306. Of these, 4,061 were single family dwelling units, 242 structures contained two or more units, and 3 mobile homes. Of the 2,476 units occupied, 2,079 were occupied by owners, the remaining 397 were rented. An estimate** of total housing units through 1973 in Dennis showed an increase of 34.2% for a total of 9,835 units, of these, 3,324 were year-round occupied units.

TABLE 5
LAND USE IN DENNIS
1951-1971

<u>Uses</u>	<u>1951</u>		<u>1971</u>	
	<u>Acres</u>	<u>% of Total</u>	<u>Acres</u>	<u>% of Total</u>
Industrial	-	-	26	.2
Commercial	26	.2	138	1.0
Residential	1,727	12.2	3,542	25.1
Transportation	3	.0	74	.5
Open & Public	88	.6	89	.6
Forest	8,253	58.5	6,774	48.0
Agriculture or Open	1,515	10.7	603	4.3
Wetland	2,460	17.2	2,392	16.9
Mining/Waste Disposal	-	-	174	1.2
Outdoor Recreation	<u>50</u>	<u>.4</u>	<u>304</u>	<u>2.2</u>
TOTALS	14,117	100.0	14,117	100.0

Source: William P. MacConnell "Remote Sensing Twenty Years of Change in the Human Environment in Massachusetts, 1951-1971"

** CCPEDC

2.40. The Harbor

2.41. Sesuit Harbor is about 3,500 feet long, averaging 500 feet in width. The harbor forms the mouth of Sesuit Creek, a narrow winding stream. The shoreline east and west of the entrance consists of moderately wide sandy beaches used by local residents for recreational swimming.

2.42. The existing locally based fleet in Sesuit Harbor is composed of 365 boats based on July 1975 statistics provided by local interests. The boats are on moorings and at marina berth. The town of Dennis can currently accommodate 233 boats at marina berths. Sesuit Marine Service can accommodate 56 boats in slips. The 76 remaining boats are moored in two areas, in deep water adjacent to the town marina and in the outer harbor at the Dennis Yacht Club.

2.43. The State has constructed two boat launching ramps, one on each side of the harbor. There are parking areas for over 100 cars and boat trailers which are filled to capacity on weekends during the summer boating season. These facilities have greatly increased the transient boating use of the harbor.

3.00 THE WITHOUT PROJECT CONDITION

3.01. Without a project, the harbor entrance will continue to shoal. It is expected that the existing fleet will expand at a slow and steady rate because of the constant demand for additional space. It has been estimated that this growth rate over a 25-year period will amount to 150 new boats.

3.02. There is sufficient space within the inner harbor to expand the town marina by approximately 250 boats. Also, Sesuit Harbor Marina has been permitted to construct a new bulkhead which would allow for expansion of 50 boat slips for a total of 300 potential new boats, but, because of the demand for boating access to deeper harbors, Sesuit Harbor will not reach this potential and be under-utilized without harbor improvement.

3.03. Therefore, with continued shoaling, a steady growth rate, and additional mooring spaces, the without project condition will be characterized by an under-utilized harbor that because of its limited access, presents safety hazards and tidal delays compounded by a growing fleet.

4.00. FORMULATING A PLAN

4.01. Because of navigation difficulties experienced in Sesuit Harbor, the town of Dennis requested a study to be made for improvement of port facilities. In developing a plan, alternatives to relieve the problem of inaccessibility and to satisfy recreational boating needs were formulated.

4.02. Generally, there are two alternatives that could accomplish this; creating new facilities, or modifying the existing facilities. As required by the Water Resource Council's Principles and Standards, a no action alternative must also be evaluated.

4.03. The development of new facilities in the mid-cape area would meet some project objectives by reducing the demand pressures on Sesuit Harbor. However, development of new facilities would be an immense undertaking, requiring construction of piers, access roads, parking facilities, and other service facilities needed by a new marina.

4.04. Three sites that had sufficient space for development of marine facilities and open anchorage, as well as space for development of onshore facilities, i.e. access roads and parking areas, were considered. Two sites, one east and one west of Sesuit Harbor, were along the north shore. The third site considered was along the South shore in the area of Bass River.

4.05. The Bass River alternative would do very little for the need for improvement along the north shore. The two sites on the north shore would require extensive investment in terms of dredging of berthing areas and navigable channels and land taking for development of onshore facilities similar to those provided by Sesuit Harbor. Because of economic impracticality and environmental factors involved in creating a new facility, this alternative was discarded from further consideration.

4.06. Modification of existing facilities at Sesuit Harbor was considered with a view towards providing access to the harbor which would be conducive to future expansion of boating facilities. The desired result would be to eliminate tidal delays, groundings and congestion at the harbor's entrance. This would also allow larger boats to utilize the harbor.

4.07. The proposed improvements to the entrance channel into Sesuit Harbor include straightening and deepening the channel. A minimum of six feet is being considered for the total improved channel depth at this site. The channel alignment would be as close to the natural channel alignment as possible. Channel width is a function of the

width of the beam of the widest boat expected to be berthed in the harbor, and the intensity of activity at the channel entrance. In the case of Sesuit Harbor, it was determined that a width of 100 feet would be the optimum dimension. The inner end of the channel at the basin entrance would have to be reduced to 80 feet to avoid expensive widening of the shoreline on both sides due to its geographical limitations.

4.08. Modification plans for Sesuit Harbor must also include some provision for disposal of dredged material. Three options for disposal were:

1. Disposal on the east bank.
2. Disposal on the west bank.
3. Disposal at sea.

Because the dredged material is made up of sand, land disposal is suitable. Disposal on the beach west of the harbor entrance was selected because it could help control erosion experienced in this area.

4.09. The no improvement alternative would not meet project objectives and is inconsistent with recreational boating needs. This alternative would permit continued shoaling of the harbor entrance. No improvement reflects the without project condition previously identified.

5.00. Discussion of Impacts

5.01. The Water Resource Council's Principles and Standards require that alternative plans continually be evaluated against planning objectives of national economic development, environmental quality, regional development, and social well-being. Interacting social, economic and environmental factors may bring about both adverse and beneficial impacts which may have short or long term effects.

5.02. Section 122 of the River and Harbor and Flood Control Act of 1970 specifies certain elements that must be considered in the effects assessment to assure that possible adverse economic, social, and environmental effects relating to the proposed project have been considered. Those adverse effects include air, noise, and water pollution; destruction or disruption of manmade and natural resources, aesthetic values, community cohesion, and the availability of public facilities and services; adverse employment effects and tax and property value losses; injurious displacement of people, businesses, and farms; and, disruption of desirable community and regional growth. These

effects are not inclusive of all those that may be discussed in an assessment. This assessment is limited, though, to the social and economic impacts of project alternatives.

5.03. Project impacts may be short or long term with site specific or regional implications. Short term effects will be felt during the construction phase as a result of the dredging and the disposal of the dredged material. It has been estimated that the dredging process will take three to six months to complete. Most likely, dredging will be undertaken during the early spring to allow for a maximum channel during the first summer. This should minimize interference with boating and bathing activities which peak during the summer. During this period, however, there will be increased levels of air and noise pollution.

5.04. Since the dredged material is composed of sand it can be deposited directly onto the beach. Disposal on the beach would be controlled by construction of temporary sand dikes to reduce excessive movement of sand during dredging operations. During these two steps of the construction phase, a temporary increase in employment will occur.

5.05. Based on estimates of shoaling rates from previous dredging operations, it is assumed that maintenance dredging would be required about once every four years. Therefore, the impacts occurring during the construction phase will occur on a four-yearly basis, although the dredging period may not be as long as for the first dredging.

5.06. Long-term effects will be realized once the construction or implementation phase is completed. Basically, the proposed plan of improvement would provide a safe entrance channel to the harbor and would provide incentive to expand existing facilities in the harbor. Disposal of dredged material has been recommended for the west shore of the entrance channel to the harbor. The placement of dredged materials on the beach will help to control erosion and improve bathing facilities.

5.07. By providing a safe entrance channel to the harbor, navigation difficulties, and damages sustained from grounding would be reduced. By providing safer navigation, operating costs would be lowered and each boater could expect optimum use of his vessel. A deeper channel would permit use of the harbor as a refuge for small craft caught in summer storms.

5.08. Additional sites within the harbor could be developed to relieve continuing needs of recreational boaters. Project implementation would permit the harbor to reach its potential capacity. The local population has already indicated an interest in enlarging the mooring capacity in Sesuit Harbor. The high demand for additional marina space is evidenced by the waiting list of boat owners looking for berthing space in Sesuit Harbor.

5.09. The keeping of waiting lists by marinas in the Cape area is not an unusual occurrence as indicated in a previous study* in which several harbormasters were interviewed. The study showed that on seasonal space, Wellfleet has a five-year waiting list, and that in Falmouth, the list never has less than 40 boats waiting for space. Most harbormasters claimed that very seldom during the boating season are there any slips empty. They admitted that too often they are forced to turn away many boaters. They also added that any new marinas would probably not affect their business.

5.10. It is anticipated that with improvement, 100 boats would be added to the fleet within two years following project construction. It is estimated that 200 boats would gradually be added over the next eight years, accounting for a fleet growth of 300 within 10 years after project implementation. Growth of the transient fleet using Sesuit Harbor is expected to occur over a 25-year period with project improvement. The growth would be equal to the size of the existing equivalent transient fleet of 76 boats.

5.11. An increased fleet size will result in increased tax revenues for the town of Dennis and increased business for local concerns servicing the boating needs. The Cee-Jay permit study set out to measure the potential impact on the local community in terms of cash paid out by pleasure boat owners and guests. Harbormasters or marina managers at several ports along the Cape Cod coast were consulted and asked to project what they felt the average transient pleasure boat tourist spends daily. In general, those consulted tended to project \$50 per person, per day, spent by transient tourists travelling by pleasure boats. The harbormasters felt that tourists travelling by boats are affluent travelers and would spend their money when given the opportunity to do so. Differences among the harbormasters' projections were due to each harbormaster's feeling as to vessel size, number of occupants per vessel and the distances traveled. Increase in local business may require an increase in employment especially during the summer months.

5.12. The proposed improvement will have a direct effect on the navigation problems and safety hazards currently experienced in Sesuit Harbor. Its implementation will also directly impact the quantity of sand and erosion control west of the entrance channel. By providing safer navigation, the project will encourage increased use of the harbor. The project complements the town's desires to meet the increasing needs of recreational boaters in Sesuit Harbor.

*U.S. Army Corps of Engineers, New England Division, Final Environmental Statement - Cee-Jay Corporation, Vol. I, App. E.

**SESUIT HARBOR
DENNIS, MASSACHUSETTS**

**DETAILED PROJECT REPORT
CHANNEL MODIFICATION FOR NAVIGATION
PERTINENT CORRESPONDENCE**

APPENDIX 4

**PREPARED BY THE
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION**



Town of Dennis
South Dennis, Mass. 02660

May 19, 1978

Office of
SELECTMEN
394-0901
EXECUTIVE SECRETARY
394-0901
ASSESSORS
394-0903
BOARD OF HEALTH
394-0905

Division Engineer
New England Division
Army Corps of Engineers
Waltham, Massachusetts 02154

Att: Mr. Anthony Garone, Project Engineer

Re: Sesuit Harbor - Dredging Project

Dear Sir:

At the Annual Town Meeting of the Town of Dennis which was held on Tuesday evening May 2, 1978 one of the Articles in the Warrant for that Town Meeting, Article #41, concerned the proposed dredging project designed by the U. S. Corps of Engineers.

The voters of the Town voted to authorize the funding for the Town's share of the project and we are enclosing, for your records, a certified copy of the Article and the vote taken under it. The certification has been furnished by the Town Clerk of the Town of Dennis.

These funds will not become available until after July 1, 1978 and we are prepared to cooperate fully with you in transferring them to the designated agency upon your request.

We appreciate your past cooperation and look forward to working closely with the Corps to the completion of this work.

Yours very truly,

Theodore M. Nelson
Executive Secretary

cc: Winn Cobb
cc: Dick Bryant

Enc.- Article 41
TMN:mm



Town of Dennis

South Dennis, Mass.
02660

Office of
TOWN CLERK
394-0908
TREASURER
394-0908


EXTRACT FROM TOWN OF DENNIS ANNUAL TOWN MEETING HELD ON MAY 2, 1978

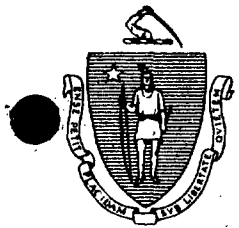
ARTICLE 42: To see if the Town will vote to raise and appropriate, transfer from available funds and/or borrow a sum of money for the purpose of dredging the entrance channel to Sesuit Harbor, and to authorize the Board of Selectmen to acquire any necessary easements for the disposal of dredged material, and further to authorize the Board of Selectmen to enter into agreements with the appropriate Federal and State agencies for assistance in defraying the total cost of the project. (By Waterways Commission)

Motion of Richard Bryant, duly seconded: "I move that the Town raise and appropriate \$12,000 and borrow \$108,000.00 under the provisions of Chapter 44, Section 7 for the purpose of dredging the entrance channel to Sesuit Harbor, and to authorize the Board of Selectmen to acquire any necessary easements for the disposal of dredged material, and further to authorize the Board of Selectmen to enter into agreements with the appropriate Federal and State agencies for assistance in defraying the total cost of the project."

It was UNANIMOUSLY VOTED.

A True Copy, Attest:


Elinor E. Slade, Dennis Town Clerk



COASTAL ZONE
MANAGEMENT

The Commonwealth of Massachusetts

Executive Office of Environmental Affairs

100 Cambridge Street

Boston, Massachusetts 02202

August 3, 1978

Joseph L. Ignazio, Chief
Planning Division
New England Division
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Mr. Ignazio:


The Office of Coastal Zone Management has reviewed your draft report on navigation improvements for Sesuit Harbor in Dennis. The report recommends the dredging of a channel 6 feet deep by 100 feet wide from Cape Cod Bay into Sesuit Harbor, for approximately 2400 feet, primarily in order to benefit recreational boating traffic. The project is anticipated to involve hydraulic dredging with disposal 500 feet west of the jetty located to the west of the proposed channel, thus allowing for the use of the clean sand for beach replenishment.

In accordance with its designated role as coordinator for federal dredge project reviews within the Massachusetts Executive Office of Environmental Affairs (EOEA), this office offers the following comments, representing the official EOEA position. Based upon the review of this project by the Department of Fisheries, Wildlife and Recreational Vehicles, the Department of Environmental Quality Engineering, the Department of Environmental Management, and the technical staff within the Office of Coastal Zone Management, this Office wholly supports the Corps of Engineers proposal to improve Sesuit harbor.

This harbor is heavily used by recreational boating traffic and is subject to a severe shoaling problem at the harbor entrance. Because of the role Sesuit Harbor plays in providing access and boating facilities for the general public, CZM has assigned high priority to the dredging of the entrance channel to this harbor. Attached is the Water Quality Certification issued by the Division of Water Pollution Control.

May I take this opportunity to commend your office on the format, comprehensiveness and general readability of your draft report.

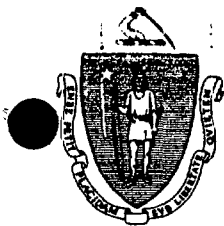
Sincerely,



Eric E. Van Loon
Director
Coastal Zone Management

EVL:SRA:sar

cc: V.L. Andreliunas, Operations, COE
Wendy Franklin, CCPEDC
Secretary Evelyn Murphy, EOE
Dredge Reviewers
file



OFFICE OF THE DIRECTOR

The Commonwealth of Massachusetts

Water Resources Commission Division of Water Pollution Control

110 Tremont Street, Boston 02108

July 17, 1978

Joseph L. Ignazio, Chief
Planning Division
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Re: Water Quality Certification
Navigation Improvements
Sesuit Harbor
Dennis

Dear Mr. Ignazio:

This agency has reviewed your draft report on navigation improvements for Sesuit Harbor, Dennis and offers the following comments thereon.

The proposed project would provide for a channel, 6 feet deep below mean low water, 100 feet wide from deep water in Cape Cod Bay to a point opposite the Dennis Yacht Club thence reducing in width to 80 feet at the entrance to the inner harbor basin, for a total channel length of 2,400 feet. Approximately 40,000 cubic yards of fine to medium sand would be removed from the channel by hydraulic methods. The sand would be deposited on the beach westward of the channel entrance. The plan is shown on Plate 1 of the report; the disposal area on Plate D-1.

The dredging portion of the project could result in a violation of water quality standards adopted by this Division. Therefore, reasonable care and diligence shall be taken by the contractor to assure that the proposed activity will be conducted in a manner which will minimize violations of said standards.

In accordance with the provisions of Sections 401 and 404 of the Federal Water Pollution Control Act as amended (Public Law 95-217), this Division hereby certifies that, based on the information furnished, there is reasonable assurance that the proposed activity will not violate applicable water quality standards adopted by this Division under authority of Section 27 (5) of Chapter 21 of the Massachusetts General Laws, said water quality standards having been filed with the Secretary of State of the Commonwealth on May 2, 1974.

Should any violation of the water quality standards occur as a result of the proposed activity, the Division will direct that the condition be corrected. Non-compliance on the part of the permittee will be cause for this Division to recommend the revocation of the permit(s) issued therefor or to take such other action as is authorized by the General Laws of the Commonwealth.

Very truly yours,

Thomas C. McMahon
Director

Joseph L. Ignazio, Chief
July 17, 1978
Page 2

cc: David Standley, Commissioner, Department of Environmental Quality
Engineering, 100 Cambridge Street, Boston 02202
Morgan Rees, Chief, Permits Branch, Corps of Engineers, 424 Trapelo
Road, Waltham 02154
John J. Hannon, Director, Division of Land & Water Use, Department of
Environmental Quality Engineering, 100 Nashua Street, Boston 02114
Allan Peterson, Director, Division of Marine Fisheries
Matthew Connolly, Director, Division of Fisheries & Wildlife
Sharon Alexander, Coastal Zone Management, 100 Cambridge Street, Boston
02202



UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
ECOLOGICAL SERVICES
P. O. BOX 1518
CONCORD, NEW HAMPSHIRE 03301

August 25, 1978

Division Engineer
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Sir:

This is the Fish and Wildlife report concerning a plan of the U. S. Army Corps of Engineers for navigation improvements at Sesuit Harbor, Massachusetts. This report is authorized by the Fish and Wildlife Coordination Act (48 Stat. 401 as amended; 16 U.S.C. 661 et seq.) and includes comments on the preliminary Detailed Project Report. It was prepared in coordination with the Massachusetts Divisions of Marine Fisheries and Fisheries and Wildlife, and the National Marine Fisheries Service.

Sesuit Harbor is located on the north side of Cape Cod in Dennis, Barnstable County, Massachusetts. It is the mouth of Sesuit Creek which is a short, tidal stream draining a salt marsh of about 160 acres. The harbor is 3,500 feet long and averages 500 feet in width. There is no existing federal project at the harbor. The existing channel was last dredged by the Commonwealth of Massachusetts in 1967 to a depth of 6 feet and spoil was deposited on the beach east of the entrance. The entrance channel now shoals to a depth of about two feet below mean low water. The jetties located at each side of the harbor entrance and revetments within the harbor were constructed by the Commonwealth.

The harbor is used by many recreational craft at moorings, transient craft using the two boat ramps, and visiting transient craft. The commercial fishing fleet consists of one small dragger and 12 lobster boats. There are few commercial fishing facilities in the harbor.

The proposed plan is authorized under Section 107 of the 1960 River and Harbor Act, and consists of deepening the channel to 6 feet below mean low water, with a one-foot overdraft allowance, to a width of 100 feet from deep water to the Dennis Yacht Club and a width of 80 feet to the entrance of the inner harbor for a total length of 2,400 feet. Spoil will amount to 40,000 cubic yards of fine to medium sand which will be placed on disposal area "A", a beach west of the entrance channel. A pipeline dredge will be used for the project which will be dredged during the early spring months. Future maintenance of the channel and the jetties will become a part of federal responsibilities.

The harbor area has small populations of mussels, hard shell clams and soft shell clams but very little shellfishing occurs. Some scallops may enter the harbor periodically. There is some fishing for flounder during the spring and fall but there is little sportfishing for other species. Adult mackerel, bluefish and striped bass may enter the harbor on rare occasions. Young bluefish are more frequently found in the harbor and young flounder are usually found in the marsh at the head of the harbor.

The offshore area provides excellent sportfishing and many boats used for sportfishing are based in Sesuit Harbor.

Without the project only a small increase in boating use is expected because of the limited depth of the entrance channel. Continued shoaling of this channel is anticipated. While there is space for an additional 250 boats it is expected that this number will not be reached due to the entrance conditions. With the project there is expected to be little impact upon shellfish, finfish or wildlife. Disturbance of existing benthic organisms in the channel area and increased suspended sediment will occur. This is expected to be temporary. There will be little impact on fish and wildlife resources at the disposal site. The project will lead to an increase in mooring spaces in the harbor which will be accomplished by local interests. An increase of 100 boats is expected within two years and an additional 200 boats would be added over the next 8 years. An increase of transient boats also is expected.

On page 10, Possible Solutions of the preliminary Detailed Project Report, dated May 1978, it is stated that local interests plan to expand the inner harbor to accommodate additional boats. This is shown in more detail on pages 1-34 and 1-35 of Appendix 1. The Environmental Assessment does not mention the anticipated expansion. The third paragraph under Benefits on page 15 of the preliminary Detailed Project Report states that maintenance dredging will take place every five years. Sites for disposal of spoil from maintenance dredging are not mentioned under Disposal Alternatives on page 1-20.

The proposed dredging of the entrance channel and disposal of spoil on the beach west of the channel entrance will have no significant long-term effects upon fish and wildlife resources. We are concerned, however, with the expansion of harbor facilities made feasible by the dredging. The salt marsh that lies at the head of the harbor is a valuable fish and wildlife resource. The Detailed Project Report should include, insofar as possible, the nature of the anticipated expansion including areas that may be dredged and proposed spoil disposal sites. This information should be provided because harbor expansion will result from the project even though the expansion will be done by local interests.



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Federal Building, 14 Elm Street
Gloucester, Massachusetts 01930

August 15, 1978

Mr. Vernon B. Lang
Assistant Supervisor
Fish and Wildlife Service
Ecological Services
P.O. Box 1518
Concord, New Hampshire 03301

Dear Vernon:

We have reviewed your report relative to navigational improvements of Sesuit Harbor at Dennis, Massachusetts and agree with it. We too are concerned about the harbor expansion and its effects on the saltmarsh at the head of the harbor, and agree that the Detailed Project Report should include harbor expansion plans of local interests, as well as plans for the disposal of spoil from maintenance dredging.

Lastly, the word "National" should be inserted in front of Marine Fisheries Service in the last sentence of the first paragraph.

Sincerely,

Christopher L. Mantzaris

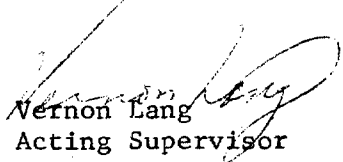


The Detailed Project Report also should include information on disposal sites for the planned periodic maintenance dredging because it is understood that federal acceptance of the project includes a commitment to maintain the channel. Disposal of spoil from maintenance dredging is a part of the project and should be considered in the planning stage even though maintenance dredging will take place in future years. We believe that the Federal Government should consider all aspects, including future commitments, of any project being proposed.

It is recommended that:

1. The Detailed Project Report include harbor expansion plans of local interests and plans for the disposal of spoil from maintenance dredging.

Sincerely yours,


Vernon Lang
Acting Supervisor



Town of Dennis
South Dennis, Mass. 02660

July 26, 1978

Office of
SELECTMEN
394-0901
EXECUTIVE SECRETARY
394-0901
ASSESSORS
394-0903
BOARD OF HEALTH
394-0905

Mr. Anthony Garone, Project Engineer
New England Division
Army Corps of Engineers
Waltham, Massachusetts 02154

Dear Mr. Garone:

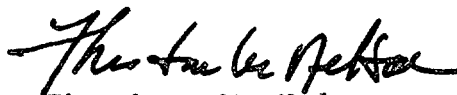
This is to acknowledge receipt of your letter of June 7, 1978 which accompanied ten copies of the draft report on navigation improvements in Sesuit Harbor. Copies of the draft report have been circulated among various town boards, committees and officers and the reception has been quite favorable.

I am enclosing a copy of a letter from Mr. Richard Bryant who is a member of our local Waterways Commission together with his comments on the report. Mr. Win Cobb, another member of the Waterways Commission, has furnished us with his comments and they are as follows:

- a. An excellent report
- b. All of the information that I felt should be part of the report was incorporated including the information on the jetties.
- c. I question the number of slips at Sesuit Marina as being an incorrect figure.

We appreciate your cooperation on this and we are prepared to assist you in the completion of the work.

Yours very truly,


Theodore M. Nelson
Executive Secretary

Enc.
TMN:mm